USM SHORT TERM GRANT NO. 304/PPSP/6131318

TRENDS OF MOTORCYCLIST ACCIDENTS IN KELANTAN AND FACTORS ASSOCIATED WITH SEVERITY OF MOTORCYCLISTS' INJURY SEEN IN HOSPITAL UNIVERSITY SAINS MALAYSIA (HUSM), KELANTAN

Principal Investigator:
PROF MADYA ABD. MANAF B. HJ.HAMID

UNIVERSITI SAINS MALAYSIA

BORANG USM J/P-06

BAHAGIAN PENYELIDIKAN & PEMBANGUNAN
CANSELORI
UNIVERSITI SAINS MALAYSIA

Laporan Akhir Projek Penyelidikan Jangka Pendek

1) Nama Penyelidik: Prof Madya Abd. Manaf b. Hj.Hamid

Nama Penyelidik-Penyelidik Lain (Jika berkaitan) :
1. Dr Mohd Ayub Sadiq @ Lin Naing
2. ASP Ahmad Zaki b. Ibrahim
3. Dr Nik Rosmawati Bt Nik Husain

2) Pusat Pengajian/Pusat/Unit : Pusat Pengajian Sains Perubatan

3) Tajuk Projek:

Trends Of Motorcyclist Accidents In Kelantan And Factors Associated With Severity Of Motorcyclists Injury Seen In Hospital University Sains Malaysia (Husm), Kelantan

4) (a) Penemuan Projek/Abstrak
(Perlu disediakan makluman di antara 100 – 200 perkataan di dalam Bahasa Malaysia dan Bahasa Inggeris. Ini kemudiannya akan dimuatkan ke dalam Laporan Tahunan Bahagian Penyelidikan & Pembangunan sebagai satu cara untuk menyampaikan dapatan projek tuan/puan kepada pihak Universiti).

ABSTRAK

TAJUK: TREND DAN FAKTOR-FAKTOR YANG MEMPUNYAI HUBUNGKAIT DENGAN KETERUKAN KECEDERAAN AKIBAT KEMALANGAN JALANRAYA DIKALANGAN PEMANDU MOTOSIKAL YANG DITEMUI DI HOSPITAL UNIVERSITI SAINS MALAYSIA (HUSM), KELANTAN

Kemalangan jalan raya menyumbang kepada sebahagian besar jumlah kematian dan kecacatan secara global. Di Malaysia, motosikal merupakan lebih dari 50% dari kenderaan yang didaftarkan, dan ia merupakan salah satu pengangkutan persendirian yang penting. Objektif kajian ini adalah untuk menentukan tren kemalangan motosikal dan kecederaan disebabkan kemalangan motosikal

yang berlaku di Kelantan dari tahun 1998 hingga 2003 dan untuk mengenalpasti faktor-faktor yang berkaitan dengan keterukan kecederaan tersebut. Kajian ini mempunyai dua bahagian. Bahagian pertama adalah pemeriksaan "retrospektif" rekod kemalangan jalanraya di Kelantan dari tahun 1998 sehingga tahun 2003. Bahagian kedua adalah kajian hirisan lintang ke atas faktor-faktor yang berkaitan dengan kemalangan motosikal, dilaksanakan melalui temubual secara bersemuka berdasarkan borang soal-selidik, dan pada masa yang sama keterukan kecederaan ditentukan berdasarkan "Revised Trauma Score". Kajian ini mendapati kebanyakan kecederaan adalah melibatkan pengguna motosikal (58.5% hingga 63.1%). Peratusan kematian adalah antara 8.6% hingga 10.7% dan kebanyakannya berumur 11-30 tahun (60.0%-69.7%). Lebih kurang 90% kemalangan maut motosikal adalah lelaki. Masa kemuncak kemalangan maut adalah antara jam 4.00 hingga 8.00 petang. Tidak ada corak bermusim kejadian kemalangan motosikal tetapi, terdapat peningkatan tren mendatar yang bermakna ($p<0.001$) dengan purata 9 kes meningkat setiap tahun. Umur melebihi 50 tahun (OR=12.87, 95% CI: 1.85, 89.58), tidak mempunyai lesen memandu motosikal (OR=14.32, 95% CI: 3.85, 53.23), tidak berhadapan dengan tekanan (OR=4.73, 95% CI: 1.64, 13.69) dan kemalangan di jalan dua hala (OR=4.78, 95% CI: 1.26, 18.10) meningkatkan risiko untuk kecederaan lebih teruk (RTS<11). Kemalangan di jalan lurus (OR=0.24, 95% CI: 0.07, 0.75), jalan basah (OR=0.09, 95% CI: 0.02, 0.55) dan tidur enam hingga kurang dari sembilan jam pada malam sebelum kemalangan (OR=0.11, 95% CI: 0.02, 0.64) mengurangkan risiko untuk kecederaan lebih teruk. Berdasarkan keputusan di atas, kami menyimpulkan bahawa tren kemalangan motosikal telah meningkat dalam tahun 1998-2003, tetapi tiada corak bermusim. Kebanyakan kemalangan maut motosikal melibatkan penunggang lelaki muda dan berlaku pada waktu petang. Umur melebihi 50 tahun, tiada lessen memandu motosikal, tidak berhadapan dengan tekanan dan kemalangan berlaku di jalan dua hala meningkatkan risiko untuk mendapat kecederaan yang teruk. Manakala tidur enam hingga kurang dari sembilan jam semalam, kemalangan di jalan lurus dan jalan yang basah menunjukkan perkaitan dengan kecederaan yang kurang teruk. Kami mencadangkan pendidikan awam, pelesenan dan penguatkuasaan terhadap pencegahan kemalangan dan pemanduan yang selamat diberi keutamaan.

ABSTRACT

TITLE: TRENDS OF MOTORCYCLIST ACCIDENTS IN KELANTAN AND FACTORS ASSOCIATED WITH SEVERITY OF MOTORCYCLISTS INJURY SEEN IN HOSPITAL UNIVERSITY SAINS MALAYSIA (HUSM), KELANTAN

Motor vehicle crashes (MVCs) contribute large proportion of death and disability globally. In Malaysia, more than 50% of the registered vehicles are motorcycle and it becomes one of the most important forms of personal transportation. Approximately 52.2% of all fatalities and 70.9% of all casualties related to MVCs in Kelantan were motorcycle riders and pillion riders. The objectives of the study were to determine the trend of motorcycle crashes in Kelantan between 1998 and 2003 and to identify factors associated with the severity of injury sustained by motorcyclist accidents. This study has two parts. Part 1 was a retrospective record review of MVCs in Kelantan between 1998 and 2003. Part 2 was a cross-sectional study on associated factors of motorcyclist accidents, assessed through face to face interviewed-based questionnaire and, at the same time the severity of injury was determined through Revised Trauma Score. The study revealed that majority of road traffic injuries involved motorcycle users (58.5% to 63.1%). The proportion of fatality was between 8.6% and 10.7% and majority involved those aged 11-30 years (60.0% – 69.7%). About 90% of the fatal motorcycle injuries were male. The peak hour for fatality was between 4.00 and 8.00 in the afternoons. There was no seasonal pattern of motorcycle accidents but, there was significant linear increasing trend over time ($p<0.001$) with an average increase of 9 cases every year. Age more than 50 years (OR=12.87, 95% CI: 1.85, 89.58), no motorcycle license (OR=14.32, 95% CI: 3.85, 53.23), no stressful condition (OR=4.73, 95% CI: 1.64, 13.69) and crash on two-way road (OR=4.78, 95% CI: 1.26, 18.10) increased the odds of getting low score (RTS<11). Accidents on straight roadways (OR=0.24, 95% CI: 0.07, 0.75) or on wet roads (OR=0.09, 95% CI: 0.02, 0.55) and drivers sleeping six to less than nine hours at night prior to accidents (OR=0.11, 95% CI: 0.02, 0.64) reduced the odds for low score. Based on the results above, we conclude that the trend of motorcycle accidents was increasing in the years 1998 - 2003, but with no seasonal pattern. Most of the fatal motorcycle crashes involved young men riders and occurred in afternoons. Age more than 50 years, no motorcycle license, no stressful condition and crashes on two-way road showed

higher risk to sustain more severe injury. However, drivers sleeping six to less than nine hours at night, crashes on straight roadways and wet road surfaces were associated with less severe injury. We recommend that public education, licensing and enforcement on accident prevention and safety riding should be given a priority.

(b) Senaraikan Kata Kunci yang digunakan di dalam abstrak:

Bahasa Malaysia	Bahasa Inggeris
Motor vehicle crashes	Kemalangan jalan raya
motorcycle crashes	kemalangan motosikal
fatality	kematian
seasonal pattern	corak bermusim

5) Output Dan Faedah Projek

(a) Penerbitan (termasuk laporan/kertas seminar)
(Sila nyatakan jenis, tajuk, pengarang, tahun terbitan dan di mana telah diterbit/dibentangkan).

1. Paper for publication in Malaysia Journal of Public Health Medicine 2004, title "Factors Associated With Severity of Motorcyclists' Injury Seen in Hospital University Sains Malaysia, Kelantan" ... the paper currently been accepted for review.
2. Paper for publication in Malaysia Journal of Public Health Medicine 2004, title "Trends Of Motorcyclist Accidents In Kelantan Between 1998-2003" ... the paper currently been accepted for review.
3. Eleventh National Public Health Colloquium, Research Priorities in Public Health, 21-22nd September 2004, The Summit Hotel, Subang Jaya USJ.
4. Fourth National Public Health Conference 2005, Galvanizing Public Health Initiatives In Enhancing Population Health, 15-17th March 2005, Marriot Putrajaya.

(b) Faedah-Faedah Lain Seperti Perkembangan Produk, Prospek Komersialisasi Dan Pendaftaran Paten.
(Jika ada dan jika perlu, sila guna kertas berasingan)

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(c) Latihan Gunatenaga Manusia

i) Pelajar Siswazah: Dr Nik Rosmawati Bt Nik Husain – Sarjana Perubatan Masyarakat

ii) Pelajar Prasiswazah: Tiada

iii) Lain-Lain : Kamariah Bt Othman (Pembantu Penyelidik)

6. Peralatan Yang Telah Dibeli:

Tiada

UNTUK KEGUNAAN JAWATANKUASA PENYELIDIKAN UNIVERSITI

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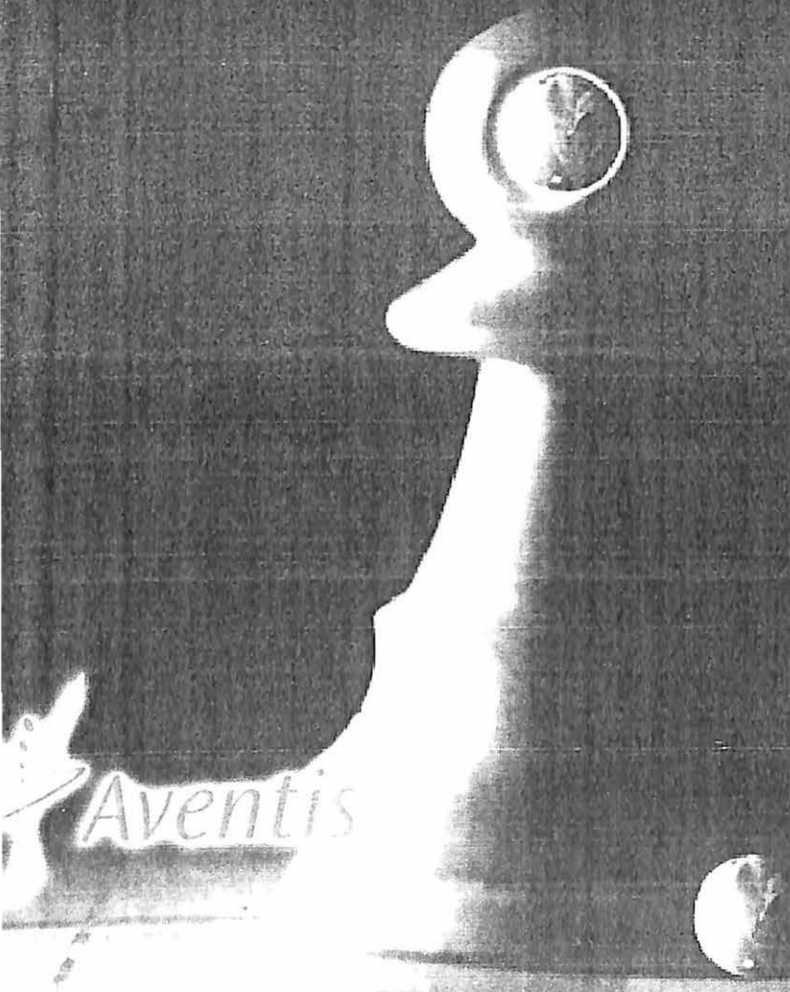
T/TANGAN PENGERUSI
J/K PENYELIDIKAN
PUSAT PENGAJIAN

Professor Zahid Azhar Mohd. Hussin
Chairman of Research & Ethics Committee
School of Medical Sciences
Health Campus
Universiti Sains Malaysia
16150 Kubang Kerian,
KELANTAN, MALAYSIA.

Eleventh National Public Health Colloquium

Research Priorities in PUBLIC HEALTH ?



Date :
21 - 22nd September 2004

Venue :
The Summit Hotel, Subang USJ

...Academy of Medicine of Malaysia.
...rsatuan Doktor Pakar Kesihatan Awam Malaysia.

Tarikh: 22 September 2004
Sidang C = Environmental Health/ Occupational Health
Pengerusi: Prof. Dr. K. G. Rampal
Bilik: Pahlawan 7 & 8

SC1SP1
8.00 – 8.13
Trends Of Motorcyclist Accidents In Kelantan Between 1998-2003
[1]**Nik Rosmawati N.H.**, [2] Manaf A.H., [2] Lin Naing @ Mohd Ayub Sadiq

SC1SP2
8.15 – 8.28
Incidence Of Needlestick Injuries In A Public Teaching Hospital
Lai Kah Lee, Noor Hassim I

SC1SP3
8.30 – 8.43
The Association Of Shift Work And Coronary Heart Disease Risk Factors Among Male Factory Workers In Kota Bharu, Kelantan
Mohd Nazri S., Tengku M.A., Choudhury SR., Winn T.

SC1SP4
8.45 – 8.58
Kecederaan Di Rumah Di Kalangan Etnik Melayu Di Kampung Meranek Dan Kampung Sindang, Sarawak
Kamaluddin B., Hashami B., Rashidah, A.W., Mariah, A., Clifton, A., Khatijah, Y. dan Win Kyi.

SC1SP5
9.00 – 9.13
Urinary 1-Hydroxypyrene: Potential Biomarker In Pah Exposure
Mohd Iqbal M.

SC1SP6
9.15 – 9.28
Prevalence And Factors Associated With Hearing Impairment Among Workers Working In Power Stations In Sarawak For The Year 2003
Mohd Nizam J. & Khiew S.K.

SC1SP7
9.30 – 9.43
Awareness Of Occupational Safety And Health Act 1994-Ten Years After Enactment
Rampal KG., Zulfa Azlin Z., Mohd Nizam J. & Noor Hassim I.

SC1SP8
9.43 – 9.58
Relative Risk Of Respiratory And Cardiovascular Case Admissions To Hospital Kuala Lumpur Associated With Increments Of Criteria Air Pollutants
Zailina, H. [1],. Jamal, H. H [2], Shamsul, B. S. [1], Ruzita, M. S. [2], Pillay, M.S. [4], Kazal, S. [4] , Zaman Huri, Z. [4], Khew, S. L. [4], Ambu, S. [4], Mazrura, S. [4], Rasimah, A. [3]

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SC1SP1

TRENDS OF MOTORCYCLIST ACCIDENTS IN KELANTAN BETWEEN 1998-2003

[1]*Nik Rosmawatit Nik Husain*, [2] *Manaf b. Abd. Hamid*, [2] *Lin Naing @ Mohd Ayub Sadiq*

Jabatan Perubatan Masyarakat, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan.

Introduction: Road Traffic Accidents (Rtas) Contribute Large Proportion Of Death And Disability Globally And Motorcyclists Are The Most Vulnerable Group. In Malaysia, Motorcycles Are One Of The Most Important Forms Of Personal Transportation. More Than 50% Of The Registered Vehicles In This Country Are Motorcycles. Casualties Among Motorcyclist Form A Large Portion Of Traffic Injury Problems In Malaysia And Are Ranked Among The Highest In Comparison To Other Countries.

Objective: To Determine The Trend Of Motorcycle Crashes And Injury In Kelantan, Between 1998-2003.

Methods: This Study Was A Retrospective Record Review Of Rtas Data In Kelantan Between 1998 – 2003 Collected From Kelantan Police Contingent Headquarter. Data Gathered Were Input Into Spss V.11 And Microsoft Excel And Analyzed Using Decomposition Method To Explore The Seasonality And Simple Linear Regression To Explore The Trend.

Results: The Majority Of Rtas Occurred At Kota Bharu District (44.1-51.1%) And Most Of Injuries Involved Motorcycle Users (59.5 – 66.2%). Among Motorcycle Injuries, The Fatality Rate Was Between 8.6 – 10.7% And Most Of Them Were Between 11-30 Years (60.0 – 69.7%). In Year 2002 And 2003, About 90% Of The Fatal Motorcycle Injuries Were Male And 26% Occurred At 4.00-8.00 Pm. In Overall, It Appeared That There Were No Definite Seasonal Pattern According To Calculated Seasonal Components, Although There Might Be Slight Reduction In Cases In December, But The Trend Was Significant (B=0.737).

Conclusions: This study identified risk groups and time conditions associated with higher motorcycle accident fatality. Accident prevention and injury reduction programme addressing the need of motorcycle riders among male at young age group and riders at late afternoon are suggested. Further study has to be done to confirm the reduction in cases in December.

SC1SP2

INCIDENCE OF NEEDLESTICK INJURIES IN A PUBLIC TEACHING HOSPITAL

Lai Kah LEE, Ismail N.H

1. International Medical University, Sesama Centre, Plaza Komanwel, Bukit Jalil, 57000 Kuala Lumpur, Malaysia
2. Faculty of Medicine, National University of Malaysia, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Kuala Lumpur, Malaysia

Needlestick injuries are one of the most common occupational injuries sustained by health care workers.

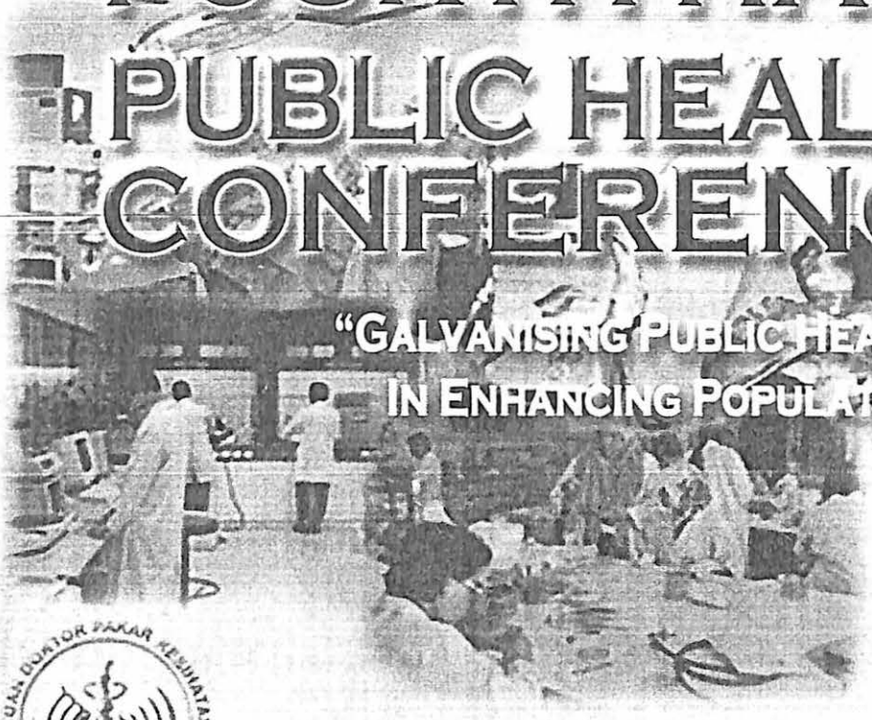
Methods: A cross-sectional study was conducted in May 2003 to study the needlestick injuries among 285 health care workers (doctors, nurses, medical students) in a teaching hospital in Negeri Sembilan.

Aims: The objective of this study is to determine the prevalence of cases and episodes of needlestick injury among these groups of health care workers in the past one-year. This study also looked at the level of knowledge on blood-borne diseases and universal precautions and the practice of universal precautions and other factors, which may contribute to the occurrence of needlestick injuries. Reporting of needlestick injuries were also studied.

Result: The incidence of needlestick injuries among the respondents is 24.6% involving 71 cases i.e. 48.0% among doctors, 22.4% among medical students, and 18.7% among nurses and the difference is statistically significant ($p < 0.001$). There were a total of 174 episodes of needlestick injury. Incidence of episode of needlestick injuries was highest among doctors (146%), followed by nurses (50.7%) and medical students (29.4%). The results showed that cases of needlestick injuries attained lower score of practice on universal precautions compared to non-cases ($p < 0.001$). About 59% of cases of needlestick injury did not report their injuries.

Conclusion: This study showed that needlestick injuries pose a high risk to health care workers and it is underreported most of the time. Many needle-sticks injuries can be prevented by strictly following the practice of universal precautions.

FOURTH NATIONAL PUBLIC HEALTH CONFERENCE 2005



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15TH - 17TH MARCH 2005

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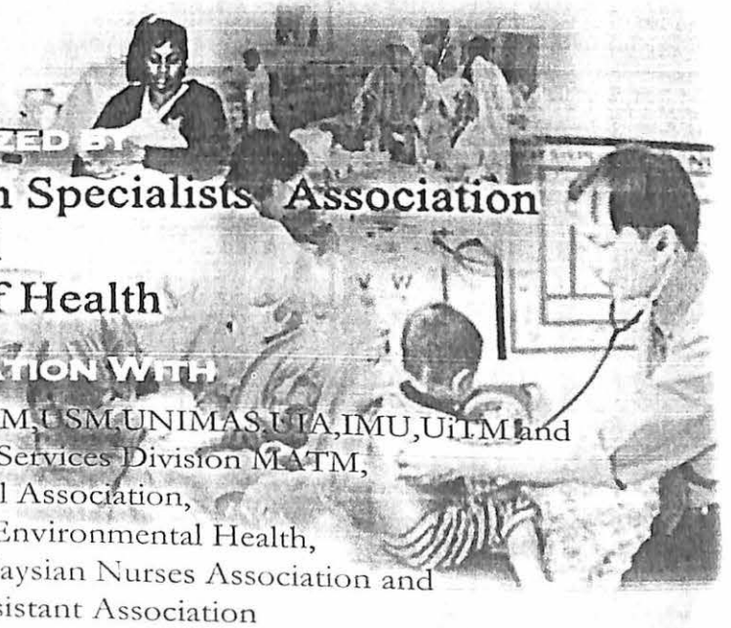
YAB DATO' SRI MOHD NAJIB

TUN HJ ABDUL RAZAK

DEPUTY PRIME MINISTER OF MALAYSIA



ORGANIZED BY

The Malaysian Public Health Specialists' Association

and

Ministry of Health

IN COLLABORATION WITH

Public Health Department of UKM,UM,UPM,USM,UNIMAS,UIA,IMU,UiTM and Academy ofMedicine, Health Services Division MATM,
Malaysia Medical Association,
Malaysian Association of Environmental Health,
Malaysian Dental Association, Malaysian Nurses Association and
Malaysian Medical Assistant Association

Bayer HealthCare

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Scope E : RESEARCH IN PUBLIC HEALTH

Date: 16 March 2005

SE1_P1 The prevalence and association of shift work and hypertension among male factory workers in Kota Bharu, Kelantan
Mohd Nazri S, Tengku M.A, Winn T, Choudhury SR

SE1_P2 Single versus multiple drug regimen in managing epilepsy: the impact on health-related quality of life
Lua Pei Lin, Getrude Cosmas, Nurul Hudani Md. Nawi

SE1_P3 Comparative measures of well-being
AP. Dr. Adinegara Bin Lutfi Abas

Life expentancy web site = www.geocities.com/adinegara/lifetable.xls

SE1_P4 Trends of motorcyclist accidents in Kelantan between 1998-2003
Nik Rosmawati N.H[1], Manaf A.H[2], Ahmad Zaki I[3], and Lin Naing S[4]

SE1_P5 Low entrance qualification contributed to the high failure rate in the final nursing examination.
Mrs. Ramziah Ahmad

Date: 17 March 2005

SE2_P6 Perception and beliefs about needle handling practices and needle stick injuries amongst hospital medical personnels.
Ghazali C, Mohd Nasir A.A, Hanizah Y, Nordin D

SE2_P7 National burden of disease: Injury
Mohd Azhadi Omar

SE2_P6 Health related quality of life among repaired cleft lip and palate patients in Wilayah Persekutuan And Selangor
Dr. Marhazlinda Jamaludin

SE2_P7 Injury prevention: The next frontier
Prof. Krishnan Rajam

SE2_P8 Molucelar epidemiology and public health: Role in communicable diseases
Dr Feisul Idzwan Mustapha

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come up with measures of well being and development of a nation (especially in relation to health). Indicators that have been formulated to look into these aspects include mortality, morbidity, nutritional status indicators, socio-economic and finally specific indices such as Physical Quality of Life Index (PQLI) and Human Developmental Index (HDI). The use of life expectancy as a parameter in both PQLI and HDI shows its importance and usefulness in assessing well-being.

SE1_P4
TRENDS OF MOTORCYCLIST ACCIDENTS IN KELANTAN BETWEEN 1998-2003

Nik Rosmawati N.H[1], Manaf A.H[2], Ahmad Zaki I[3], and Lin Naing S[4C]
Community Medicine Department, University Sains Malaysia, Kubang Kerian, Kelantan

Background: Motor vehicle crashes (MVCs) contribute large proportion of death and disability globally and motorcyclists are the most vulnerable group. In Malaysia, motorcycles are one of the most important forms of personal transportation. More than 50% of the registered vehicles in this country are motorcycles. Casualties among motorcyclist form a large portion of traffic injury in Malaysia and are ranked among the highest in comparison to other countries.

Objective and methods: The objective of the study was to determine the trend of motorcycle crashes in Kelantan, between 1998 and 2003. This was a retrospective record review of MVCs data in Kelantan. Data gathered were input into SPSS version 11 and Microsoft Excel and analyzed using decomposition method to explore the seasonality and simple linear regression to explore the trend.

Results: the study revealed that majority of road traffic injuries involved motorcycle users (58.5% to 63.1%). The proportion of fatality was between 8.6% and 10.7% and majority involved 11-30 years (60.0%-69.7%). About 90% of the fatal motorcycle injuries were male. The peak hour for fatality was between 4.00 to 8.00 afternoons. No seasonal pattern of motorcycle accidents but, there were significant linear increasing trend ($p<0.001$) with an average of 9 cases increasing every year.

Conclusion: The trend of motorcycle accidents was increasing in year 1998-2003, but no seasonal pattern. Most of the fatal motorcycle crashes involved young men riders and occurred at afternoon. We recommend that public education and enforcement on accident prevention should be given a priority.

SE1_P5
LOW ENTRANCE QUALIFICATIONS CONTRIBUTED FOR THE HIGH FAILURE RATE IN THE FINAL NURSING EXAMINATION.

Mrs. Ramziah Ahmad
Institute of Health Management, Ministry of Health

Statistics collected by The Malaysian Board of Nursing on the final nursing examination conducted by the Training Division of Ministry of Health showed, in year 2004 and only 44.4% passed. The objective of the study was to determine the factors contributing to the high failure rate and formulate recommendations. A postal survey was conducted to include all Nursing Colleges (MOH and private). In this study 1,331 students (63.1%) and 281 tutors (77.6%) responded. The high failure rate was observed highest among the Malay students who studied in the government colleges. Having a below acceptable level of entrance qualification seem to be the cause of failure. Higher percentages of passes were noted among students with diploma qualification or having at least a credit physic, Biology and Chemistry. However basic Science taught in Art Stream does not play a significant role. The perception of the tutors was that in the past few years, the entrance qualifications for nursing students have been downgraded. This has resulted in the students having difficulties in understanding the basic nursing curriculum. It is recommended that candidates intending to pursue nursing as their career should have an entrance qualification consisting of at least a credit in Biology, Chemistry of Physics. Due to circumstances, if the Ministry is forced to

MANUSKRIP

TITLE: TRENDS OF MOTORCYCLIST ACCIDENTS IN KELANTAN BETWEEN 1998-2003

Nik Rosmawati N.H.[1], Manaf A.H[2]., Ahmad Zaki I[3]. and Lin Naing S[4].

[1]Postgraduate student (Environmental Health), Community Medicine Department, Universiti Sains Malaysia, Kubang Kerian, Kelantan

[2]Lecturer, Community Medicine Department, Universiti Sains Malaysia, Kubang Kerian, Kelantan.

[3]Police officer, Ibupejabat Polis Kontinjen Kelantan,

[4]Medical Statistician and Lecturer, School of Dental Sciences, Universiti Sains Malaysia, Kubang Kerian, Kelantan

Abstract

Motor vehicle crashes (MVCs) contribute large proportion of death and disability globally and motorcyclists are the most vulnerable group. In Malaysia, motorcycles are one of the most important forms of personal transportation. More than 50% of the registered vehicles in this country are motorcycles. Casualties among motorcyclist form a large portion of traffic injury problems in Malaysia and are ranked among the highest in comparison to other countries. The objective of the study was to determine the trend of motorcycle crashes in Kelantan, between 1998 and 2003. This was a retrospective record review of MVCs data in Kelantan. Data gathered were input into SPSS version 11 and Microsoft Excel and analyzed using decomposition method to explore the seasonality and simple linear regression to explore the trend. The study revealed that majority of road traffic injuries involved motorcycle users (58.5% to 63.1%). The proportion of fatality was between 8.6% and 10.7% and majority involved 11-30 years (60.0% – 69.7%). About 90% of the fatal motorcycle injuries were male. The peak hour for fatality was between 4.00 to 8.00 afternoons. No seasonal pattern of motorcycle accidents but, there was significant linear increasing trend ($p<0.001$) with an average of 9 cases increasing every year. Based on the results above, we conclude that the trend of motorcycle accidents was increasing in year 1998 - 2003, but no seasonal pattern. Most of the fatal motorcycle crashes involved young men riders and occurred at afternoon. We recommend that public education and enforcement on accident prevention should be given a priority.

1. Introduction

All road users have a risk to be involved in MVCs. A study on road traffic accident mortality from MVCs in Singapore found that the largest group of road traffic accident fatalities involved motorcyclists (39.8%) (Wong *et al.*, 2002). In Malaysia, in 2001 the largest group of motor vehicle injuries was motorcyclists (60.1%), followed by occupants (9.3%), motorcar drivers (8.6%) and pedestrians (7.4%). Out of 6,035 fatalities, 51.7% involved motorcyclists, 12.3% passengers, 11.9% pedestrians and 9% motorcar drivers (RMP, 2001). In Kelantan, approximately 52.2% of all fatalities and 70.9% of all casualties related to RTAs were motorcycle riders and pillion riders (RMP, 2003). A number of risk factors have been established in the relationship between road

users and traffic accidents. Factors that are of importance are related to the road-user, the vehicle as well as road and traffic conditions (Subramaniam, 1998).

2. Methods

The design of the study was a cross-sectional and data collection was started in January 2004. The data were extracted from the secondary data of all MVCs in Kelantan from 1998 to 2003 at the Kelantan Police Contingent Headquarters. All cases of MVCs in Kelantan was taken according to districts, types of vehicles, types of injuries, by age, by gender, by time of accident occurred in term of days of the week, hours, year and month. Data entry was done using SPSS® version 11.0 (SPSS Inc., 2000) and Microsoft Excel®. To observe the trends of motorcycle accidents in Kelantan, firstly the sequence plot was used and then the analysis was done using decomposition methods for time series analysis. Initially the deseasonalisation was done using twelve months moving average and followed by central moving average. Seasonal components (SC) and seasonal indexes (SI) for all months were calculated. To look the pattern of SC compared to the average of SC for all months, the results of SCs were plotted in a graph for every month. The same steps were used using the eleven months moving average. Simple linear regression analysis was used to determine the trend of motorcycle accidents. The goal of this study was to determine the trend of motorcycle crashes in Kelantan between 1998

3. Results

3.1 Distribution of motorcycle crashes

The total number of MVCs in Kelantan in this five year period was 3, 5261 cases. The number of MVCs increased every year within a ranged of 3.9% to 12.3 with relatively highest in year 2000. Most of the MVCs occurred in Kota Bharu District and the least was in Jeli. Majority of MVCs in Kelantan in 1998-2003 involved car ranging from 58.7% to 64.4% out of total MVCs. The total number of motor vehicle injuries between 1998 and 2003 was 14,875 cases and motorcycle accidents contributed the largest proportion of motor vehicle injuries. The number of injuries due to motorcycle accidents increased yearly, ranging from 58.5% to 63.1% out of total road traffic injuries in Kelantan (9068 cases). The trend of injuries was shown in sequence plot (Figure 3.1).

The type of injuries was categorized into fatal and non fatal. Fatal injury represents any person who died within 30 days as a result of an accident and non fatal injury included both serious and minor injuries. This study found that the number of fatalities among motorcycle crashes in Kelantan were increasing and ranged from 8.6% to 10.7% in 1998 to 2003.

Only three years data were available for the fatal motorcycle injuries by age. Most of fatal motorcycle injuries involved young riders aged 11-30 years (60.0%, 62.1%, and 69.7% in 2001, 2002 and 2003 respectively). The proportions of fatalities among age group more than 50 years were 18.7% (2001), 20.0% (2002) and 22.1% (2003).

Regarding gender, days of the week and time-of-day distribution, data was available for only year 2002 and 2003. The proportion of male involved in fatal motorcycle injuries in this two years period were 89.7% and 92.2% respectively. The highest number of fatality in 2002 and 2003 were on Friday (18.2%) and Monday (20.8%). The time-of-day distribution for the occurrence of fatal motorcycle injuries exhibited peak at 4.0 to 8.00 pm (26%-28%) followed by at 12.00 – 4.00 pm (16% - 24%), while the lowest numbers of fatal motorcycle injuries occurred between 12.00 midnight and 4.00 am (6%-10%).

3.2 Pattern of motorcycle crashes

The pattern of motorcycle crashes in Kelantan between 1998 and 2003 was described in Figure 3.2. Generally, no systematic or consistent seasonal pattern was observed. However, obvious increasing trend was observed. The results of seasonal components and indexes (based on seasonal decomposition method) were presented in Table 3.1. This result clearly showed that there were no consistent seasonal components. For example in January, the number of cases was above the average in 1999 and 2002, but below the average in 2001 to 2003. Except in December, the result showed some consistency (consistently below the average). However, the magnitude of the fluctuation was quite low (Seasonal Index -14.4: in average of 14.4 cases below the average). Therefore, the result suggested that there was no definite seasonal pattern in the data for 1998 to 2003.

The analysis on the linear trend by using Simple Linear Regression was presented in Table 3.2. The result suggested that, there was a significant linear increasing trend ($p<0.001$). There were about an average of 9 cases increasing every year (0.74 cases x 12 months=8.8 cases). The linear model well fit as indicated by the residual plot.

4. Discussion

This study revealed that the number of MVCs in Kelantan increased within a range of 3.9%-12.3% increment in this five years period. In the year 2000, it was found that MVCs to be relatively higher compared to the other years, corresponding to two Hari Raya Aidilfitri in that year (in January and December). Out of 3, 5261 cases of MVCs in this study period in Kelantan, majority of these crashes occurred in Kota Bharu (16,346 cases) and involved car accidents followed by motorcycle accidents. Out of 14,875 road traffic injuries, 58.5% to 63.1% resulted from motorcycle accidents (9,068 cases). This finding is consistent with report by Radin Umar *et al.* (1998) that approximately 68% of all injuries in Malaysia involved motorcyclists and their overall relative risk is about 20 times higher compared to the passenger cars. Whereas in Indonesia, it was noted that motorcycles were involved in 64% of all traffic accident injuries (Conrad *et al.*, 1996). However, Yuan (2000) reported that motorcyclist and pillion rider only accounted for 49.9% out of total number of road casualties in Singapore in 1996. The obvious higher percentage involved motorcycle users indicate that they are the most vulnerable group on the road.

The number of fatalities among motorcycle crashes in Kelantan increased ranging from 8.6% to 10.7% in 1998 to 2003. Study done by Roudsari *et al.* (2004) reported that, the mortality rate for motorcyclists was 2.1%. Another study by Leonard and Frick (1998) stated that the fatality risk in the driver seat of the motorcycle exceeds that in the

passenger seat by 26 ± 2 %. And Wong *et al.* (2002) found that the relative risk of mortality between motorcyclists and motorcar drivers was 18.8:1. These figures indicate that motorcyclists are exposed to high risk of fatality compared to other types of road users.

Most of fatal motorcycle injuries in Kelantan in year 2001-2003 involved young riders aged between 11-30 years (60.0%-69.7%). The involvement of children less than 16 years indicates that the parents still allowed their children to drive in spite of not having driving license. The legal age for riding motorcycle in Malaysia is 16 year. In year 2002 and 2003, majority (89.7% and 92.2% respectively) of these fatal injuries involved man. The outnumbered of this young age group and male also found in Sweden where the median age of motorcycle riders admitted to hospitals due to accidents was 22 years and 95% of the riders were male (Wladis *et al.*, 2003). Thailand also revealed the high proportion of male (69%) motorcycle riders involved in the accidents, and most riders were under below 21 years of age (Sirathranont & Kasantikul, 2003). This could be explained by behavioral differences between sexes, women being possibly more inattentive or less experienced or skilled than men, but perhaps less risk-taker, less risky driving habits and less risk of loss-of-control accidents. The involvement of younger age group and more confined to men bring a big impact to the country, and can cause economic losses and reduced human power.

The peak time for fatal motorcycle injuries was at 4.00 to 8.00 pm. This is comparable with a study in Thailand where the peak of all motorcycle crashes was found between 6.00 pm and 9.00 pm (Sirathranont & Kasantikul, 2003). However, in a study by Yau (2004) commented that a higher risk of severe injury was observed for accidents that happened at 8.00 pm to 11:59 midnight (OR= 6.562, 95% CI= 1.794, 24.002) and from 08:00 am to 11.59 am (OR= 4.220, 95% CI= 1.051, 16.941. Valent *et al.* (2002) also reported the OR of death rather for driving at early morning hours and evening were 13.44 (95% CI= 2.54, 71.05) and 6.67 (95% CI= 1.49, 29.95) respectively. The reasons for the high risk of accidents and fatalities among the motorcycle riders in overseas could be related to the greater used of alcohol during that time. Meanwhile, in Malaysia especially in Kelantan, the use of alcohol is not a major concerned. At 4.00 to 8.00 pm. is the rush hours period after office hour. At this time the riders may trap in heavy traffic congestions and probably go home with a stress mode, sleepy, fatigue or tiredness and therefore affecting the concentration on riding.

There was no definite seasonal pattern in the motorcycle accidents data for this study period. Our finding showed that there was probably no effect of the festive seasons or raining seasons on this seasonality pattern. Similar results also found by Singaporean study in which no seasonal effects on injury severity was noted (Quddus *et al.*, 2002). It may be due to lack of seasonal climatic variations in Malaysia as well as in Singapore, which sits near the equator. However, further exploration using larger sample size and longer duration of motorcycle accidents data is suggested to explore the effect of the seasonality. Although this study only look on five years data, but it was found that, there was significant linear increasing trend ($p<0.001$) with an average of 9 cases increasing every year. This indicates a slow increasing trend in the number of motorcycle accidents in Kelantan. The possible explanation for this is that the number of road users was increasing every year causing traffic congestion and yet this cannot be prevented. In a study done by Wang *et al.* (2003) on the trends in road traffic crashes in China, it was revealed that an increased in the crash, fatality and injury rates was due

to increased motorization spurred by rapid economic growth. At the same time, motorcycle is still the commonest road transport used in Kelantan and as well as in Malaysia because it is the cheapest and efficient road transport that everybody can afford it. According to the Royal Malaysia Police Report (2001), the number of registered private motorcycles in Kelantan was shown to be increased by 2.7% through out the year in 2000 and 2001 (from 210,775 to 216,496).

The probable reasons for the slow increasing trend are the increase in the awareness of the riders with the increase in socioeconomic status, continuous enforcement of the road safety policy and increase in the road safety education through billboards, mass media as well as electronic sources by the government. Scuffham & Langley (2002) revealed in their study that the trend of the traffic crashes was influenced by unemployment rate, gross domestic product per capita, alcohol consumption, road policy and economic crisis. Their study found that as economic activities increase drivers may travel further, increasing exposure, and consequently the number of crashes may increase. But, economic growth may also increase the level of vehicle safety measure, and consequently the number of crashes may decrease. Therefore, it is important to look for the other modifiable risk factors that contribute to the increase risk of accident among motorcycle users and factors associated with injury severity. Perhaps, by knowing these, it will help in prioritize and planning the programs related to injury prevention and reduction.

5. Conclusions and recommendations

The trend of motorcycle accidents has been increasing from the year 1998 until 2003, but there were no definite seasonal pattern. Most of the fatal motorcycle crashes involved young men riders and occurred in the afternoon. In Malaysia, road traffic has increased with the average annual traffic growth is approximately 17% per year (Radin Umar *et al.*, 1996). This may be the possible explanation for the increasing in trend of motorcycle crashes. Obviously, the traffic growth cannot be stopped but, accident prevention and injury reduction programme must address motorcycle riders among male at young age group and motorcyclists who ride their motorcycles in the afternoon.

Education focusing to the younger age groups is recommended. This includes a development of a new syllabus to those who are going to get motorcycle license. Currently, all riders that are applying for a driving license must attend a course based on same syllabus regardless of the types of license. But, it is suggested that, the syllabus for the motorcycle license must include the risk factors such as more safety precautions while riding after office hours and the other road factors. Short-courses on crash prevention especially involving parents, younger age individuals, and students must be introduced and promoted. Learning institutions especially primary and secondary schools should be used as the primary targets to conduct accident prevention programme among this age group. School health units, which are usually responsible for informing pupils about health risks with alcohol, smoking and drug use, also could inform individuals about risk factors when they begin to ride the motorcycles. Driving teachers are another strategic group who could inform future drivers about these risk factors. Lastly but not least, parents can play a significant role in giving continuous education to their kids about road safety measures.

Road safety enforcement should be conducted throughout the year and not only focused

during certain time periods like the festive seasons. Scuffham & Langley (2002) reported that these road policy factors appeared to have a greater influence on crashes than the role of demographic and economic factors. For example, an 11% increase in accidents was associated with the increase in the open road speed limit from 80 to 100 kph.

Proper registration on all trauma cases is suggested. For better documentation, this trauma registry would involve a few major parties such as medical or hospital-based expertise, insurance companies, police department and Road Transport Department

The usual limitation of a police record is that the unreported cases especially for the minor cases of injury or accident that involved unlicensed riders resulted in over represent of severely injured riders. Another limitation is police records only categorized the accident as a fatal accident when the victim died within 30 days due to accident. However, it did not include the long term effect of the accident. Secondary data restrict better measure on the prevalence or rate of the motorcycle accidents. For example the rate of accident per 1000 population or per registered vehicle or road length.

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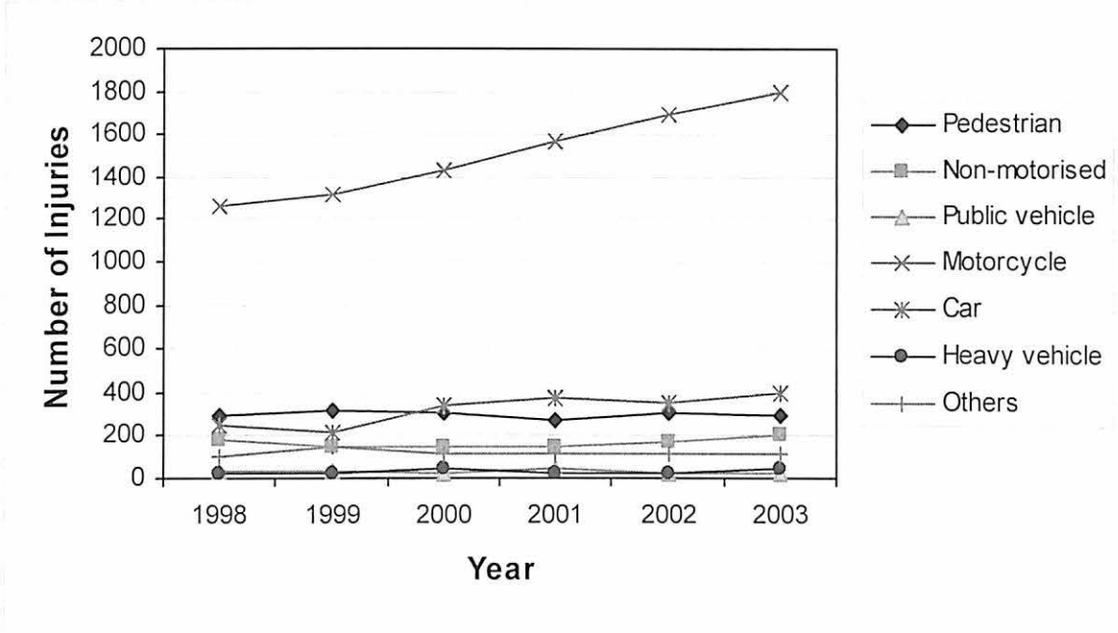

Figure 3.1 Sequence plot of motor vehicle injury by types of road user

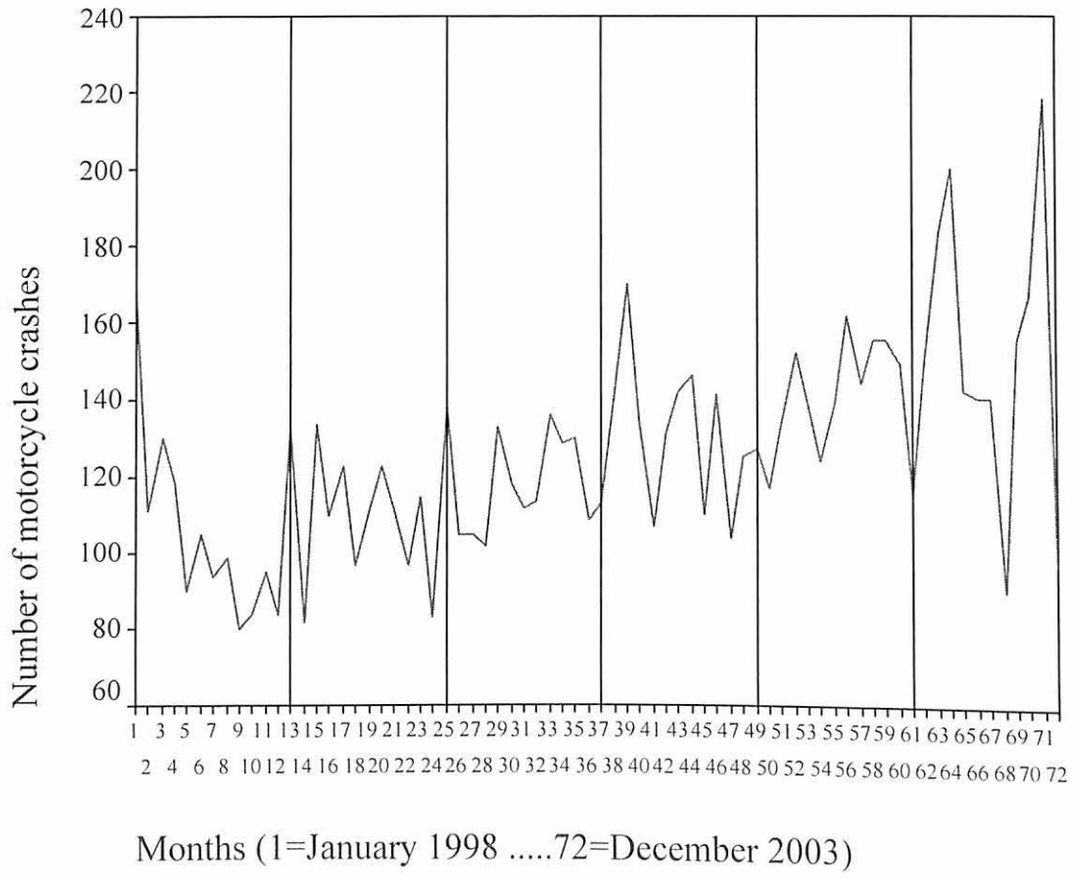

Figure 3.2 Trend of motorcycle crashes by month in Kelantan (1998-2003)

Table 3.1 Seasonal components and seasonal indexes for number of motorcycle crashes in January – December (1998-2003)

Month	Seasonal Component						Seasonal Index
	1998	1999	2000	2001	2002	2003	
January		31.000	27.000	-15.667	-2.875	-37.792	0.451
February		-21.750	-6.625	12.750	-13.375	0.125	-6.116
March		27.917	-7.250	38.500	1.583	35.625	19.634
April		2.042	-12.583	3.083	17.583	51.708	12.784
May		13.667	16.458	-23.333	0.875	-9.375	0.418
June		-13.125	-0.250	1.083	-16.250	-11.833	-8.232
July	-9.375	1.667	-6.250	10.833	-1.750		-3.004
August	-1.792	11.458	-4.792	15.375	19.375		7.984
September	-19.750	0.708	12.875	-18.000	-1.042		-4.866
October	-15.542	-12.750	1.833	13.750	5.917		-0.949
November	-5.542	5.167	2.583	-25.292	3.750		-3.699
December	-17.583	-28.125	-17.875	-5.292	-3.083		-14.366

Table 3.2 Trend of motorcycle accident cases by using simple linear regression

Variable	Regression coefficient (*b*)	95% CI	*t*-statistic	*p*-value
Month	0.74	0.48-0.99	5.69	<0.001

Analysis of simple linear regression: residual plot suggest SLR fits well. R^2 of the model is 0.316. Dependent variable is number of motorcycle accidents and independent variables is months in sequence number.

FACTORS ASSOCIATED WITH SEVERITY OF MOTORCYCLISTS INJURY SEEN IN HOSPITAL UNIVERSITY SAINS MALAYSIA (HUSM), KELANTAN

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Abstract

All road users are at risk of being involved in motor vehicle crashes (MVCs). Approximately 52.2% of all fatalities and 70.9% of all casualties related to MVCs in Kelantan were motorcycle riders and pillion riders. A number of risk factors have been established in the relationship between traffic accidents and road-user, the vehicle as well as road and traffic conditions. The study was a cross-sectional study to identify factors associated with the severity of injury sustained by motorcyclist accident patients admitted to Emergency Department, Hospital Universiti Sains Malaysia (HUSM), assessed through face to face interviewed-based questionnaire and, at the same time the severity of injury was determined through Revised Trauma Score. Data analysis was done using simple and multiple logistic regressions. The study revealed that age more than 50 years, no motorcycle license, no stressful condition and crashes on two-way road showed higher risk to sustain more severe injury. However, sleep six to less than nine hours per day, crash on straight roadway and wet road surface were associated with less severe injury. We recommend that public education, licensing and enforcement on accident prevention and safety riding should be given a priority.

Key Words: *Motor Vehicle Crashes, Motorcycle, Injury Severity, Revised Trauma Score.*

1. Introduction

Motor Vehicle injuries are a major public health problem (Leveque *et al.*, 2001). Between 1990 and 2020, it is estimated that motor vehicle crashes (MVCs) will move from the ninth to the third largest cause of death and disability globally. Over 90% of this death and disability will occur in the developing world, in which a large proportion of vehicles are two or three wheeled (Mullin *et al.*, 2000). Motorcycle crashes are a serious cause of morbidity and mortality especially in young males. Sinha *et al.* (1995) stated that of those admitted to hospital due to motorcycle injuries, the average length of stay was 38.7 days (range 1-25 days), 67% needed intensive therapy unit and 41.3% needed ventilation for an average 3.55 days (range 1-17 days). Injury is also a leading

contribution to health-related economic losses (Mock, 2001). Orsay *et al.* (1995) wrote that motorcycle trauma patients with severe or critical head injuries used a significantly greater proportion of ICU days and hospital charges than those with mild or no head injuries

Casualties among motorcyclist form a large portion of traffic injury problems in Malaysia and are ranked among the highest in comparison to other countries. Approximately 68% of all injuries in Malaysia involved motorcyclists and their overall relative risk are about 20 times higher compared with the passenger cars (Radin Umar *et al.*, 1998). According to Royal Malaysian Police (2001), 40.9% of total fatal MVCs involved motorcycle and the fatality rate per 10 kilometers road length was 0.47 with no much change since 1998. In 2003 alone, a total number of 95,545 motorcycles were reported to have been involved in MVCs resulting in 34,248 injuries in Malaysia. Out of the total of 6286 fatalities and 46,455 serious and slight injuries throughout the country in 2003, approximately 56.4% (3548 cases) of all fatalities and 66.1% (30,700 cases) of all casualties were motorcycle riders and pillion riders (Royal Malaysian Police, 2003).

Of all MVCs in Malaysia, the over-representation of motorcycle fatal accidents (60%) (Radin Umar *et al,* 1998) warrants a high degree of concern. Apart from being largely populated, motorcyclists are also vulnerable and are highly exposed to fatality risks on the road. So it is vital to identify the factor that correlates with the severity of motorcyclist accidents in order to provide information which would be useful to identify priorities for motorcycle injury prevention and education among motorcycle riders. This information is also essential for the Public Health Policy and direct emergency medical health service resource allocations. Identification of potential risk factors also have important implications to other relevant official organizations involved in modifying safety measures that will reduce the occurrence of severe motorcycle accidents, which eventually, would help to promote a safe road environment.

The goal of this study was to identify factors associated with the severity of injury sustained by motorcyclist accident patients admitted to Emergency Department (ED), Hospital Universiti Sains Malaysia (HUSM). A number of risk factors have been established in the relationship between road users and MVCs. Factors that are of importance are related to the road-user, the vehicle as well as road and traffic conditions (Subramaniam, 1998).

2. Methods

The study was a cross-sectional study carried out from Septembert 2003 till January 2004. All motorcyclists' injury involved in accidents in Kota Bharu and seen in Emergency Department (ED), HUSM during 5 months study period were included in this study. Systematic random sampling was applied to get the random study subjects. All cases of study subject attended at ED, HUSM at the time of the arrival after getting the informed consents either from subject itself or their relatives. There were two types of research tools used; questionnaire form and Revised Trauma Score. All information in questionnaires was recorded as risk factors for injury severity.
Revised Trauma Score (RTS) is one of the trauma scoring systems to assess the injury severity. It converts the severity of injury into a number. The RTS defines three

variables: Glasgow Coma Scale (GCS), respiratory rate, and systolic blood pressure. A coded value from 0 to 4 is assigned for each variable. A score is generated from these three coded values. An RTS score can range from 0 to 12 with lower scores representing increasing severity. The calculation of RTS is as shown below.

Revised Trauma Score = (value for Glasgow Coma Scale) + (value for systolic blood pressure) + (value for respiratory rate)

The RTS has been shown to have high inter-rater reliability and demonstrated accuracy in predicting death. The RTS also correlates well with the probability of survival. The RTS is heavily weighted towards the GCS to compensate for major head injury without multisystem injury or major physiological changes (Champion *et al.*, 1989). RTS score was assessed by the medical officer at the first seen of the patient. All information in questionnaires was recorded as risk factors for injury severity. Data entry and data analysis was done using SPSS version 11.0 (SPSS Inc., 2000) and STATA version 7 (Stata Corp., 2001) using simple and multiple logistic regressions.

3. Result

A total of 150 motorcyclist crash patients were recruited in this study. Only 33 patients (22%) presented with low RTS (RTS <12) and 177 (78%) with high RTS (RTS=12). Table 1 describes the distribution of studied factors and results of simple logistic regression analysis of the associated factors with the injury severities. Malays were the majority ethnic group and male were predominant. Majority was between 11 – 30 years with the mean age of 26.3 years. A greater proportion of the victims were unmarried and with education level up to secondary and tertiary schools. The proportion of unemployed and students were slightly smaller than non-professional workers. Many of the subjects were from family with monthly income of ≥RM680.00, family members of seven or less and stayed in house with three or more rooms. The cut-off point for RM680.00 was based on the moderate level of income in Kelantan (doubling the poverty line, RM340.00). The mean number for household size (number of persons stayed together) was 5.86 with the minimum and maximum number of household size were 2 and 12 respectively.

Used motorcycle was outnumbered and majority of the motorcycle were >5 years in age. There were a slightly higher proportion of motorcycles that were involved in the crash with engine volumes between 70 to 100cc. However, only a small percentage of the motorcycle did not have a well functioning brake and a small number of the motorcyclists did turn on the headlight when the crash occurred. More than half of the riders had no motorcycle license and rode their motorbike at 40km/hour or less. Many of the subjects used helmet, however, majority did not wear fluorescent jacket. There were a greater proportion of the riders who had had stressful condition one week prior to the crash, but many received social support when needed. A higher percentage of the riders slept six to less than nine hours at night before involved in the crashes.

Majority of the crashes occurred on straight road, two-way types of road and on dry road surface. Generally, riders who did not carry the passenger, drove at day time and on weekends accounted for the greater proportion of the accidents. Vehicle-vehicle accidents had a higher percentage being involved in the accidents compared to collision

with non-vehicle. In addition, back or side of impaction accounted for many of the cases. Less than half of the riders involved in the accidents hit other road users.

From the univariate analysis, the significant factors associated with injuries severity of motorcyclist accidents were age and education level of the riders, age of the motorcycles, motorcycle license, helmet use, stressful condition and life satisfaction, type of roads, roadway surface and side of impaction.

Table 2 showed the summary of results for multiple logistic regression analysis. Age of the rider, driving license, stressful condition, sleep period, roadway alignment, types of road and roadway surface were the significant factors associated with injuries severity of motorcyclist accidents. Other factors were not included in the final model due to non-significant results. There was no multicollinearity between the variables. Two way interactions were not significant. Hosmer-Lemeshow Goodness-of-fit statistic revealed Chi-Square (df=8) of 4.67 and p value of 0.792. ROC curve revealed as the area under the curve of 0.89 (Figure 4.11). The classification table was 92.3% sensitivity, 48.5% specificity and 82.7% correctly classified with the cut-off point of 0.5 predicted probability. Thus, the model was reasonably fit.

4. Discussion

Factors such as age of the rider, driving license, stressful condition, sleep period, roadway alignment, type of road and roadway surface were found to be significantly associated with the severity of the motorcycle injury in HUSM because these variables are strongly associated. In fact, this study may miss the other non-significant important variables because of lack of power to detect them (due to small sample size).

The marginally not significant variables detected in this study were state roadway (p=0.085), municipal/others roadway (p=0.064), collision object (p=0.105), engine volume (p=0.65), side of impaction (p=0.07), dress color of the riders (p=0.064) and rider's status (p=0.100). Even though this study failed to reveal the significant findings, a few other studies demonstrated that following motorcycle accidents, injuries tended to be more severe when the collision occurred on a highway or main road (Stevensen *et al.*, 1992). Quddus *et al.* (2002) pointed that collision with a stationary object was found to have the greatest increase in the probability of fatality by 480% compared with collision to other vehicles and pedestrians. The significant finding also noted by Lin *et al.* (2003) who found the collisions with a moving car, a parked car or another stationary object increased the odds for a greater injury severity.

Regarding the engine volume, it was demonstrated by Wick *et al.* (1998) where 50% of the motorcycle accidents in Germany happened with motorcycles between 500 and 700 cc engine volume and Quddus *et al.* (2002) reported that, a 1500 cc motorcycle, relative to the reference case of 170.29 cc, results in a 202% increase in the probability of fatal MVCs. However, in the same study by Lin *et al.* (2003) revealed that no significant differences in the levels of injury severity were detected among various motorcycle engine volumes. Therefore, further study should be done in a larger sample size to demonstrate these marginally not significant variables were really not important factors in determine the levels of injury severity.
Motorcycle riders more than 50 years of age tend to have a greater probability for more severe injury compared to younger riders (11-30 years). One would expect this age

group to be frailer and most vulnerable road users probably because of co-morbidity, which reduces the possibility of recovery from trauma. This is consistent with the statement by Shankar and Mannering (1996) that although older riders tend to ride at lower speeds and hence less likely to be in an accident, they tend to have more severe injuries once involved in an accident. Wladis *et al.* (2003) also reported that high age was associated with higher death rates in admitted motorcyclists. Harris *et al.* (2003) demonstrated that a sharp rise in mortality between ages 45 and 55 and an increased death rate from complications were observed. They also show increase in ICU lengths of stay, overall length of stay, and cost for geriatric trauma patients.

The effect of driving without license was significantly associated with a low RTS. This finding is in line with statement by Lin *et al.* (2003) that riders with no valid motorcycle license were marginally associated with a greater level of injury severity (adjusted OR=1.26; 95% CI: 1.00, 1.59) whereas, riders with a valid license were less likely to be involved in a crash than those without, with relative hazard of 0.95 (95% CI, 0.85-1.06). Murray (1998) also reported that drivers were more frequently involved in accident during the first year of obtaining their driving license, irrespective of age. These findings demonstrated that those without valid license will have a greater risk of involved in an accident as well as more risk to get severe injury. Currently, those who are going to obtain a driving license must undergo a special driving course or class and should pass in the examination either in a theory part or in practical situation. This will expose the candidates to the basic knowledge on the road safety measures and rules that the road users must follow, and therefore increased the awareness of safety precautions while on the road.

Surprisingly, the odds for a low level of RTS from motorcycle crashes involved riders with no stressful condition was 4.73 compared to those with stressful condition. This suggested that the presence of stress did not lead to severe injury. The possible reason is that those with a stressful condition may try to release it by doing other activities like seeking help from their friends or relative. However, this study failed to demonstrate the effect of social support on injury severity. The other reasons are the questionnaire probably failed to obtain and classified a stressful condition of the respondents especially when the respondents were relatives of the patients (for the severely injured patients) and this questionnaire asked on the stressful event within one week prior to the accident. Possibly there may be no effect on the behavior of motorcycle riders after a few days having stress.

Having enough sleep are also important factors that determine the injury severity. Our study revealed that the odds of getting low RTS among those who slept six to less than nine hours per day was 0.11 times compared to those who slept less than six hours a day. The rationale is that, not having enough sleep may cause fatigue and risk of falling asleep while riding especially at early hours of the morning and in the middle of the afternoon. Unfortunately, this study revealed no significant association between injury severity and time-of-day and day of motorcycle accidents. The probable reason may be due to small sample size that restricts this study to further categorize the effect of time into shorter period.

Motorcycle crash occurred at straight roadway noted to have four times odds of getting high RTS compared to accident on the bend roadway or junction. This finding is consistent with the statement by Quddus *et al.* (2002) that bends in the road appear to

result in more severe injuries and increase the probability of fatality by 71.6%. Crashes at the bends in the road or at the junctions may result in motorcyclists leaving the travel lanes and overturning or striking an off-road object such as a guardaril, rocks or trees.

Designs of the road noted do play a role in the injury severity among motorcycle-involved crashes. This study found that having an accident on the two-way road seems to have more severe injury compared to an accident occurred at dual carriage or one-way road. This is in agreement with the findings by Quddus *et al.* (2002) who noted that higher road design standards increased the probability of severe injuries and fatalities for this type of accidents. The most logical explanation for this is on two-way street the riders tend to speed more or made an interception to other moving vehicles and at the same time exposed themselves to the opposite moving vehicles. However, this study failed to demonstrate the effect of speeding on the severity of injury. This could be due to the subject did not confessed that they were speeding.

Those who had crashes on the wet road demonstrated the odds of sustained more severe injury almost 0.09 times compared to those who had accidents on the dry road. This finding is comparable to other study by Quddus *et al.* (2002) who stated that the probability of fatalities of wet road surface relative to dry road surface among motorcycle injury decreases by 20.6%. These similar findings can be explained by the fact that riding under these conditions caused the riders to reduce speed levels as a compensation for the increased risk of driving when road surfaces are wet.

Because a substantial proportion of motorcycle crashes cannot be easily avoided, an increased emphasis on reducing injury severity at the time of the crash is needed.

Motorcyclist is the most vulnerable group in the motor vehicle crashes and a few factors have shown to be related with the severity of the motorcycle injury. Severe motorcycle injuries have deep implications in long-term health care financial costs. Therefore, this study may provide support and knowledge to the policy maker to plan strategies, so that motorcycle riders will have less risk of getting more severe injury when involved in MVCs. Identification of risk factors provides an important piece of information for relevant official organizations to use in the strengthening the trauma centers and modification of road safety measures.

5. Conclusions and recommendations

The study identified several modifiable factors and non-modifiable associated with injury severity among motorcycle crashes. Riders of more than 50 years of age, not having motorcycle license, do no have stressful condition and an accident on two-way road were found to have higher risk to sustain more severe injury. However, those who slept six to less than nine hours per day, riding on straight roadway and on wet road surface were associated with less risk to sustain more severe injuries.

Education and licensing focusing to the younger and older age groups is recommended. This includes a development of a new syllabus to those who are going to get motorcycle license and this syllabus must include the risk factors that was found to be associated with injury severity. Learning institutions especially primary and secondary schools should be used as the primary targets to conduct accident prevention programme among this younger age group. Short-courses on crash prevention

especially involving parents, younger age individuals, students and the elderly must be introduced and promoted. For those more than 50 years, it is recommended that they should undergo retest on road safety every five years before renewing their license. And at the same time, the approval from doctors regarding their health status especially concerning on vision, hearing and other physical fitness would be better.

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Table 1 Distribution of studied factors and results of simple logistic regression analysis for factors associated with severity of motorcyclist injuries in HUSM

FACTORS	Frequency (%)		Crude OR [a] (95% CI [b])	Wald-statistic	*p*-value
	Low Score (n=33)	High Score (n=117)			
RACE				0.04[d]	
Malay	31 (93.9)	111 (94.9)	1.00	-	-
Non Malay	2 (6.1)	6 (5.1)	1.19 (0.23, 6.21)	0.21	0.833
GENDER				1.40[d]	
Male	30 (90.9)	97 (82.9)	1.00	-	-
Female	3 (9.1)	20 (17.1)	0.49 (0.13, 1.75)	-1.11	0.268
AGE, year				6.24[d]	
11 – 30	22 (66.7)	87 (74.3)	1.00	-	-
31 – 50	5 (15.1)	25 (21.4)	0.79 (0.27, 2.30)	-0.43	0.667
>50	6 (18.2)	5 (4.3)	4.75 (1.33, 16.99)	2.39	**0.017**
STATUS				0.00[d]	
Unmarried	23 (69.7)	82 (70.1)	1.00	-	-
Married	10 (30.3)	35 (29.9)	1.02 (0.44, 2.36)	0.04	0.966
EDUCATION				7.02[d]	
No schooling/Primary school	9 (27.3)	10 (8.5)	1.00	-	-
Secondary school/Tertiary	24 (72.7)	107 (91.5)	0.25 (0.09, 0.68)	-2.71	**0.007**
OCCUPATION				0.02[d]	
Unemployed/Student	16 (48.5)	55 (47.0)	1.00	-	-
Non professional	17 (51.5)	62 (53.0)	0.94 (0.45, 2.04)	-0.15	0.881
MONTHLY FAMILY INCOME				0.66[d]	
<RM680.00	15 (45.5)	44 (37.6)	1.00	-	-
≥RM680.00	18 (54.5)	73 (62.4)	0.72 (0.33, 1.58)	-0.81	0.416
NO. OF FAMILY MEMBER				0.00[d]	
≤7	18 (54.5)	64 (54.7)	1.00	-	-
>7	15 (45.5)	53 (45.3)	1.01 (0.46, 2.19)	0.02	0.987
NO. OF ROOM				2.23[d]	
<3	11 (33.3)	24 (20.5)	1.00	-	-
≥3	22 (66.7)	93 (79.5)	0.52 (0.22, 1.21)	-1.52	0.128
HOUSEHOLD SIZE				0.00[d]	
	5.88 (2.27) [c]	5.85 (2.32) [c]	1.00 (0.85, 1.19)	0.05	0.957
MOTORCYCLE STATUS				1.26[d]	
New	13 (39.4)	59 (50.4)	1.00	-	-
Used	20 (60.6)	58 (49.6)	1.56 (0.71, 3.44)	1.12	0.265

Table 1, continued

FACTORS	Frequency (%)		Crude OR [a] (95% CI [b])	Wald-statistic	*p*-value
	Low Score (n=33)	High Score (n=117)			
AGE OF MOTORCYCLE				7.43[d]	
≤5 years	5 (15.2)	46 (39.3)	1.00	-	-
>5 years	28 (84.8)	71 (60.7)	3.63 (3.31, 10.07)	2.47	**0.013**
ENGINE VOLUME, cc				3.71[d]	
70 – 100	22 (66.7)	56 (47.9)	1.00	-	-
>100	11 (33.3)	61 (52.1)	0.46 (0.20, 1.01)	-1.89	0.059
BRAKE				0.37[d]	
Functioning well	30 (90.9)	110 (94.0)	1.00	-	-
Not functioning well	3 (9.1)	7 (6.0)	1.57 (0.38, 6.45)	0.63	0.530
HEADLIGHT				0.58[d]	
On	28 (84.8)	105 (89.7)	1.00	-	-
Off	5 (15.2)	12 (10.3)	1.56 (0.51, 4.81)	0.78	0.436
RIDING EXPERIENCE				1.07[d]	
	11.09 (9.85) [c]	9.32 (8.09) [c]	1.02 (0.98, 1.07)	1.05	0.293
MOTORCYCLE LICENSE				15.74[d]	
Yes	9 (27.3)	77 (65.8)	1.00	-	-
No	24 (72.7)	40 (34.2)	5.13 (2.18, 12.08)	3.75	**<0.001**
RIDING SPEED, km/h				0.66[d]	
≤40	19 (57.6)	58 (49.6)	1.00	-	-
>40	14 (42.4)	59 (50.4)	0.72 (0.33, 1.58)	-0.81	0.418
RIDING DISTANCE, km				0.27[d]	
≤2	20 (60.6)	65 (55.6)	1.00	-	-
>2	13 (39.4)	52 (44.4)	0.81 (0.37, 1.79)	-0.52	0.605
HELMET USE				7.70[d]	
Yes	18 (54.5)	93 (79.5)	1.00	-	-
No	15 (45.5)	24 (20.5)	3.23 (1.42, 7.33)	2.81	**0.005**
FLUORESCENT JACKET				0.42[d]	
Yes	2 (6.1)	4 (3.4)	1.00	-	-
No	31 (93.9)	113 (96.6)	0.55 (0.10, 3.14)	-0.67	0.500
DRESS COLOR				2.02[d]	
Bright	19 (57.6)	51 (43.6)	1.00	-	-
Dark	14 (42.4)	66 (56.4)	0.57 (0.26, 1.24)	-1.41	0.158
STRESSFUL CONDITION				8.85[d]	
Yes	17 (51.5)	92 (78.6)	1.00	-	-
No	16 (48.5)	25 (21.4)	3.46 (1.54, 7.81)	2.99	**0.003**
LIFE SATISFACTION				4.97[d]	
Satisfied	25 (75.8)	64 (54.7)	1.00	-	-
Not satisfied	8 (24.2)	53 (45.3)	0.39 (0.16, 0.93)	-2.13	**0.033**
SOCIAL SUPPORT				0.09[d]	
Easy	27 (81.8)	93 (79.5)	1.00	-	-
Difficult	6 (18.2)	24 (20.5)	0.86 (0.32, 2.32)	-0.30	0.768
SLEEP PERIOD				3.05[d]	
<6 hours	6 (18.2)	11 (9.4)	1.00	-	-
6 - <9 hours	21 (63.6)	92 (78.6)	0.42 (0.14, 1.26)	-1.55	0.121
≥9 hours	6 (18.2)	14 (12.0)	0.79 (0.20, 3.12)	-0.34	0.732

Table 1, continued

FACTORS	Frequency (%)		Crude OR [a] (95% CI [b])	Wald-statistic	*p*-value
	Low Score (n=33)	High Score (n=117)			
ROADWAY CATEGORY				1.70[d]	
Federal	8 (24.2)	41 (35.0)	1.00	-	-
State	15 (45.5)	41 (35.0)	1.88 (0.72, 4.90)	1.28	0.200
Municipal/Others	10 (30.3)	35 (30.0)	1.46 (0.52, 4.12)	0.72	0.469
ROADWAY ALIGNMENT				2.20[d]	
Straight	17 (51.5)	77 (65.8)	0.55 (0.25, 1.21)	-1.49	0.136
Bend/Junction	16 (48.5)	40 (34.2)	1.00	-	-
TYPE OF ROAD				9.25[d]	
Two way	4 (12.1)	45 (38.5)	4.53 (1.49, 13.75)	2.67	**0.008**
Others	29 (87.9)	72 (61.5)	1.00	-	
HOLE ON ROAD				0.07[d]	
Yes	5 (15.2)	20 (17.1)	1.00	-	-
No	28 (84.8)	97 (82.9)	1.15 (0.40, 3.35)	0.26	0.792
ROADWAY SURFACE				8.18[d]	
Dry	31 (93.9)	85 (72.6)	1.00	-	-
Wet	2 (6.1)	32 (27.4)	0.17 (0.04, 0.76)	-2.33	**0.020**
WEATHER CONDITION				2.59[d]	
Raining	2 (6.1)	19 (16.2)	1.00	-	-
Not raining	31 (93.9)	98 (83.8)	3.01 (0.66, 13.63)	1.43	0.154
VISUAL OBSTACLE				0.89[d]	
No	23 (69.7)	91 (77.8)	1.00	-	-
Yes	10 (30.3)	26 (22.2)	1.52 (0.64, 3.60)	0.96	0.339
CARRYING PILLION RIDER				0.09[d]	
Yes	6 (18.2)	24 (20.5)	1.00	-	-
No	27 (81.8)	93 (79.5)	1.16 (0.43, 3.13)	0.30	0.768
TIME OF ACCIDENT				0.67[d]	
Night	7 (21.2)	33 (28.2)	1.00	-	-
Day	26 (78.8)	84 (71.8)	1.46 (0.58, 3.69)	0.80	0.424
DAYS OF ACCIDENT				0.52[d]	
Weekends	7 (21.2)	32 (27.4)	1.00	-	-
Weekdays	26 (78.8)	85 (72.6)	1.40 (0.55, 3.54)	0.71	0.479
COLLISION OBJECT				1.21[d]	
Non-vehicle	8 (24.2)	40 (34.2)	1.00	-	-
Vehicle	25 (75.8)	77 (65.8)	1.62 (0.67, 3.93)	1.08	0.282
SIDE OF IMPACTION				5.31[d]	
Front	21 (63.6)	48 (41.0)	2.52 (1.13, 5.59)	2.26	**0.024**
Back/Side	12 (36.4)	69 (59.0)	1.00	-	-
TYPE OF COLLISION				0.70[d]	
Hit	12 (36.4)	52 (44.4)	0.71 (0.32, 1.59)	-0.83	0.408
Been hit/Others	21 (63.6)	65 (55.6)	1.00	-	-

[a] OR: Odds Ratio
[b] CI: Confidence Interval
[c] mean (Standard Deviation)
[d] Likelihood Ratio statistic
Dependent variable is "Revised Trauma Score": high score=0, low score=1

Table 2 Multiple logistic regression analysis for factors associated with severity of motorcyclist injuries admitted in HUSM

Factors	Adjusted Odds Ratio	95% CI [a]	LR [b] statistic	*p*-value
AGE, year			7.09	
11 – 30	1.00	-		-
31 – 50	1.09	0.26, 4.61		0.907
>50	12.87	1.85, 89.58		0.010
MOTORCYCLE LICENSE			21.94	
Yes	1.00	-		-
No	14.32	3.85, 53.23		<0.001
STRESSFUL CONDITION			8.68	
Yes	1.00	-		-
No	4.73	1.64, 13.69		0.004
SLEEP PERIOD			7.52	
<6 hours	1.00	-		-
6 - <9 hours	0.11	0.02, 0.64		0.014
≥9 hours	0.31	0.04, 2.11		0.230
ROADWAY ALIGNMENT			6.51	
Straight	0.24	0.07, 0.75		0.015
Bend/Junction	1.00	-		-
TYPE OF ROAD			6.33	
Two way	4.78	1.26, 18.10		0.021
Others [c]	1.00	-		-
ROADWAY SURFACE			9.87	
Dry	1.00	-		-
Wet	0.09	0.02, 0.55		0.009

LAPORAN AKHIR

TRENDS OF MOTORCYCLIST ACCIDENTS IN KELANTAN AND FACTORS ASSOCIATED WITH SEVERITY OF MOTORCYCLISTS' INJURY SEEN IN HOSPITAL UNIVERSITY SAINS MALAYSIA (HUSM), KELANTAN

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ABBREVIATIONS

AIS	Abbreviated Injury Scale
AP	Anatomic Profile
APACHE	Acute Physiology and Chronic Health Evaluation
ASCOT	A Severity Characterization of Trauma
CI	Confidence interval
ED	Emergency Department
Freq	Frequency
GCS	Glasgow Coma Scale
HUSM	Hospital Universiti Sains Malaysia
ICD	International Classification of Disease
ICU	Intensive care unit
ICISS	International Classification of Diseases-based on Injury Severity Scale
ISS	Injury Severity Scale
IQR	Inter-quartile range
Km	Kilometer
KPH	Kilometer per-hour
LR test	Likelihood Ratio test
MLR	Multiple logistic regression
MVCs	Motor vehicle crashes
OR	Odds ratio
PTS	Pediatric Trauma Score
RMP	Royal Malaysian Police
ROC	Receiver Operator Characteristic curve
RR	Respiratory rate

RTS	Revised Trauma Score
SBP	Systolic blood pressure
SC	Seasonal component
SD	Standard deviation
SI	Seasonal index
SLR	Simple linear regression
TRISS	Trauma and Injury Severity Score
TS	Trauma Score
VIF	Variance-inflation-factors

ABSTRAK

Kemalangan jalan raya menyumbang kepada sebahagian besar jumlah kematian dan kecacatan secara global. Di Malaysia, motosikal merupakan lebih dari 50% dari kenderaan yang didaftarkan, dan ia merupakan salah satu pengangkutan persendirian yang penting. Objektif kajian ini adalah untuk menentukan tren kemalangan motosikal dan kecederaan disebabkan kemalangan motosikal yang berlaku di Kelantan dari tahun 1998 hingga 2003 dan untuk mengenalpasti faktor-faktor yang berkaitan dengan keterukan kecederaan tersebut. Kajian ini mempunyai dua bahagian. Bahagian pertama adalah pemeriksaan "retrospektif" rekod kemalangan jalanraya di Kelantan dari tahun 1998 sehingga tahun 2003. Bahagian kedua adalah kajian hirisan lintang ke atas faktor-faktor yang berkaitan dengan kemalangan motosikal, dilaksanakan melalui temubual secara bersemuka berdasarkan borang soal-selidik, dan pada masa yang sama keterukan kecederaan ditentukan berdasarkan "Revised Trauma Score". Kajian ini mendapati kebanyakan kecederaan adalah melibatkan pengguna motosikal (58.5% hingga 63.1%). Peratusan kematian adalah antara 8.6% hingga 10.7% dan kebanyakannya berumur 11-30 tahun (60.0%-69.7%). Lebih kurang 90% kemalangan maut motosikal adalah lelaki. Masa kemuncak kemalangan maut adalah antara jam 4.00 hingga 8.00 petang. Tidak ada corak bermusim kejadian kemalangan motosikal tetapi, terdapat peningkatan tren mendatar yang bermakna ($p<0.001$) dengan purata 9 kes meningkat setiap tahun. Umur melebihi 50 tahun (OR=12.87, 95% CI: 1.85, 89.58), tidak mempunyai lessen memandu motosikal (OR=14.32, 95% CI: 3.85, 53.23), tidak berhadapan dengan tekanan (OR=4.73, 95% CI: 1.64, 13.69) dan kemalangan di jalan dua hala (OR=4.78, 95% CI: 1.26, 18.10) meningkatkan risiko untuk kecederaan lebih teruk (RTS<11). Kemalangan di jalan lurus (OR=0.24, 95% CI: 0.07, 0.75), jalan basah (OR=0.09, 95% CI: 0.02, 0.55) dan tidur enam hingga kurang dari sembilan jam pada malam sebelum

kemalangan (OR=0.11, 95% CI: 0.02, 0.64) mengurangkan risiko untuk kecederaan lebih teruk. Berdasarkan keputusan di atas, kami menyimpulkan bahawa tren kemalangan motosikal telah meningkat dalam tahun 1998-2003, tetapi tiada corak bermusim. Kebanyakan kemalangan maut motosikal melibatkan penunggang lelaki muda dan berlaku pada waktu petang. Umur melebihi 50 tahun, tiada lessen memandu motosikal, tidak berhadapan dengan tekanan dan kemalangan berlaku di jalan dua hala meningkatkan risiko untuk mendapat kecederaan yang teruk. Manakala tidur enam hingga kurang dari sembilan jam semalam, kemalangan di jalan lurus dan jalan yang basah menunjukkan perkaitan dengan kecederaan yang kurang teruk. Kami mencadangkan pendidikan awam, pelesenan dan penguatkuasaan terhadap pencegahan kemalangan dan pemanduan yang selamat diberi keutamaan.

ABSTRACT

Motor vehicle crashes (MVCs) contribute large proportion of death and disability globally. In Malaysia, more than 50% of the registered vehicles are motorcycle and it becomes one of the most important forms of personal transportation. Approximately 52.2% of all fatalities and 70.9% of all casualties related to MVCs in Kelantan were motorcycle riders and pillion riders. The objectives of the study were to determine the trend of motorcycle crashes in Kelantan between 1998 and 2003 and to identify factors associated with the severity of injury sustained by motorcyclist accidents. This study has two parts. Part 1 was a retrospective record review of MVCs in Kelantan between 1998 and 2003. Part 2 was a cross-sectional study on associated factors of motorcyclist accidents, assessed through face to face interviewed-based questionnaire and, at the same time the severity of injury was determined through Revised Trauma Score. The study revealed that majority of road traffic injuries involved motorcycle users (58.5% to 63.1%). The proportion of fatality was between 8.6% and 10.7% and majority involved those aged 11-30 years (60.0% – 69.7%). About 90% of the fatal motorcycle injuries were male. The peak hour for fatality was between 4.00 and 8.00 in the afternoons. There was no seasonal pattern of motorcycle accidents but, there was significant linear increasing trend ($p<0.001$) with an average increase of 9 cases every year. Age more than 50 years (OR=12.87, 95% CI: 1.85, 89.58), no motorcycle license (OR=14.32, 95% CI: 3.85, 53.23), no stressful condition (OR=4.73, 95% CI: 1.64, 13.69) and crash on two-way road (OR=4.78, 95% CI: 1.26, 18.10) increased the odds of getting low score (RTS<11). Accidents on straight roadways (OR=0.24, 95% CI: 0.07, 0.75) or on wet roads (OR=0.09, 95% CI: 0.02, 0.55) and drivers sleeping six to less than nine hours at night prior to accidents (OR=0.11, 95% CI: 0.02, 0.64) reduced the odds for

low score. Based on the results above, we conclude that the trend of motorcycle accidents was increasing in the years 1998 - 2003, but with no seasonal pattern. Most of the fatal motorcycle crashes involved young men riders and occurred in afternoons. Age more than 50 years, no motorcycle license, no stressful condition and crashes on two-way road showed higher risk to sustain more severe injury. However, drivers sleeping six to less than nine hours at night, crashes on straight roadways and wet road surfaces were associated with less severe injury. We recommend that public education, licensing and enforcement on accident prevention and safety riding should be given a priority.

CHAPTER 1

INTRODUCTION

1.1 Motor vehicle crashes as a new public health issue

Injuries resulting from motor vehicle crashes (motor vehicle injuries) are a major public health problem (Leveque *et al.*, 2001). Nowadays, Motor vehicle crashes (MVCs) represent an important cause of morbidity and mortality (Duma, 2002). The global burden of disease reported in 1990, about 5 million people died of injuries of all types worldwide, with two-thirds of them being men with heavy concentration among young adults. In this age group, MVCs fall within ten leading causes of death (Murray *et al.*, 1998). Mock (2001) also reported that injury is the commonest cause of death among children and young adults in developed and middle-income countries. In low-income countries, deaths in this age group are most often due to infectious diseases, but there is a rising rate of deaths from injury, and MVCs alone are 3 of the 6 killers of older children and second only to AIDS as a killer of young adults.

Numerous studies on the mortality rate due to MVCs have been done overseas. In the United States, Whitfield & Fife (1987) stated that the overall motor vehicle mortality rate in 1980 was 23 deaths per 100,000 per year. Dessie & Larson (1991) reported that the overall incidence density rate of the road traffic injury in Ethiopia was 279.4 per 100,000 person-years and the mortality rate was 17.6 per 100,000 populations per year. Road traffic injury and fatality rates were 946 and 59.5 respectively per 10,000 registered vehicles. In Sweden, despite the fact that fatal accidents are seven times less

frequent than that of non-fatal, MVCs are still the leading cause of death among its young people (Murray, 1998).

Murray (1998) emphasized on the health problem, especially in terms of potential years of lost life (PYLL) that arises from MVC-related ill-health and premature death, and reported that its magnitude on PYLL was the second biggest in the developing regions, surpassed only by depression. It was noted that the overall years of person life lost was 595 per 100,000 person-years exposure (Dessie & Larson, 1991). With regard to this, Whitfield & Fife (1987) has also mentioned that the number of years of life lost to motor vehicle crash injury before age 70 has increased by 84 percent between 1940 and 1980. In another descriptive study in Romania, Duma (2002) reported that, the level of PYLL due to road accidents in male is significantly higher compared to female (964 and 408 respectively).

The financial impact of MVC is tremendous. Government need to spend a large amount of money on the treatment and rehabilitation of accident casualties. Vehicle or property damages related to accidents also cause a substantial amount of financial and physical loss to the country. In Switzerland, 900 people die in traffic accidents annually. Many victims of tragic accidents become permanently disabled. The annual direct and indirect costs of traffic injuries are 3 billion Swiss francs. 6% of this is devoted to medical treatment. The other parts are used for the compensation of income and disability lost productivity (Martinoli *et al.*, 1993). According to the Royal Malaysian Police (2001), the total damage to vehicles and properties attributable to MVCs in Malaysia totaled up to approximately RM 181 million in year 1995 alone.

1.2 Road users and risk of accident

All road users stand a risk to be involved in MVCs. A study on road traffic accident mortality from MVCs in Singapore found that the largest group of road traffic accident fatalities involved motorcyclists (39.8%). The second most common road traffic accident fatalities were pedestrians (27.9%). Pillion riders came in third (11.9%) as there were probably fewer of them compared to motorcyclists and pedestrians (Wong *et al.*, 2002).

However, Murray (1998) reported that car was the most common mode of transportation involved in accidents for both men and women. Additionally, among the young male drivers, motorcycle was the second most common mode of transport involved in MVCs. There were also slightly more bicycle accidents among women than among men.

Different results were found by different researchers. In Ghana, pedestrian deaths constituted the single largest group (46.2%) of fatalities among all road users, followed by passengers of buses and minibuses (21.2%) and passengers of trucks (10.8%). This study showed pedestrians accounted for 66.8% of all fatalities and 43.3% of all casualties, especially in urban areas (Afukaar *et al.*, 2003). Similar result was also reported by Rodriguez *et al.* (2003) who found that 32% of injuries and 40% of fatalities involved pedestrians. A study in China showed that, of all road users killed in road traffic accidents, pedestrians constituted 26%, passengers 23%, motorcyclists 17%, bicyclists 16%, and automobile drivers accounted for 10% (Wang *et al.*, 2003).

In Malaysia, the largest group of motor vehicle injuries in 2001 was motorcyclists (60.1%), followed by passengers (9.3%), motorcar drivers (8.6%) and pedestrians (7.4%). Out of 6,035 fatalities, 51.7% involved motorcyclists, 12.3% passengers, 11.9% pedestrians and 9% motorcar drivers (Royal Malaysian Police, 2001).

A lot of efforts and finance resources have been channeled to the preventive and control measures to combat this problem in Malaysia. Among the measures that have been done in Malaysia include road safety campaigns through bill-boards, mass media, education materials and others as well as rigorous research conducted by Road Safety and Research center, Universiti Putra Malaysia. In addition, Royal Malaysian Police have been running Ops Sikap, a concerted activities aimed at reducing MVCs over the past 7 years. This Ops Sikap (previously known as Ops Pacak and Ops Statik) involve high risk locations during festive seasons where there are a lot of vehicles on the road.

1.3 Injury severity scoring systems

The categorization of injury has been of interest to the military since record keeping began. The evolution of trauma scoring in the modern era began during the 1950s with research on light-plane accidents, and subsequently on automobile crashes. Trauma scoring systems convert the severity of injury into a number. According to Chawda *et al.* (2004) the scoring system should be reliable, specific and accurate.

1.3.1 Use of Scoring Systems

Trauma scoring systems will serve various useful purposes such as to predict the outcome of trauma, as a comparison of therapeutic methods, as a pre- and inter-hospital triage tool, as a tool for quality-improvement and prevention programme, as well as a tool for trauma research (Chawda *et al.*, 2004).

1.3.2 Types of trauma scoring system

According to Chawda *et al.* (2004) and Senkowski & McKenney (1999), many systems have been developed to assess the severity of the trauma or injury. The classifications of these systems are based on physiological scores and anatomical scores, and lately there have been attempts to combine the scores. The above authors found that, the commonly used trauma scoring systems are as followed

A. Physiological scores

These scoring systems consist of weighted variables representing the major physiological systems, including neurological, cardiovascular, respiratory, renal, gastrointestinal, metabolic and hematological variables. This includes;

1. Glasgow Coma Scale (GCS)
2. Trauma Score (TS) and Revised Trauma Score (RTS)
3. Acute Physiology and Chronic Health Evaluation (APACHE)

B. Anatomical scores

Anatomical scoring systems representing the injury severity based on the site of injured body region. This includes;

1. Abbreviated Injury Scale (AIS)
2. Injury Severity Scale (ISS)
3. Pediatric Trauma Score (PTS)
4. International Classification of Diseases-based ISS (ICISS)
5. Others– Anatomic Profile (AP), ICD-9

C. Combined scores

These methods combine both anatomical and physiological measures of injury severity and patient age in order to predict survival from trauma. Methods used are:

1. Trauma and Injury Severity Score (TRISS)
2. A Severity Characterization Of Trauma (ASCOT)

Bouillon *et al.* (1997) in their paper concluded that all trauma score systems showed high accuracy rates and valid tools for patient classification and support. However, the three common instruments that have been used in injury scoring are: the injury severity scoring; the revised trauma score; and the paediatric trauma score. The PTS is specifically designed for children (Beattie *et al.*, 1998). Among the physiologic scores, RTS is one of the most commonly used (Chawda *et al.*, 2004). According to Senkowski & McKenney (1999), RTS is the most widely used as prehospital field triage tool and it stood the test of time.

1.3.3 Revised Trauma Score

Senkowski & McKenney (1999) in their article stated that, in 1981, Champion and associates published the TS as a system for field triage. The author hypothesized that most of early trauma deaths were secondary to injury to one or more of the three systems; central nervous system, cardiovascular system and respiratory system. So, in developing the TS, five variables were included; Glasgow Coma Scale (GCS), Respiratory rate (RR), Respiratory expansion, Systolic blood pressure (SBP) and capillary refill. TS have a strong inter-rater reliability. In 1989, they re-evaluated the TS and create the RTS. In this scoring system, respiratory expansion and Capillary refill were dropped because of difficulty in assessing while in the field and a wide margin for interpretation.

The RTS only defines three variables: GCS, RR, and SBP. A coded value from 0 to 4 is assigned for each variable. A score is generated from these three coded values. An RTS score can range from 0 to 12 with lower scores representing increasing severity as shown in Table 2.1 (Senkowski & McKenney, 1999).

Table 2.1 Revised Trauma score

Coded value	Glasgow Coma Scale	Systolic blood pressure	Respiratory rate
4	13 – 15	>89 mmHg	10 – 29 /min
3	9 – 12	76 – 89 mmHg	>29 /min
2	6 – 8	50 – 75 mmHg	6 – 9 /min
1	4 – 5	1 – 49 mmHg	1 – 5 /min
0	3	Nil	Nil

The calculation of RTS is as shown below.

Revised Trauma Score = (value for Glasgow Coma scale) + (value for systolic blood pressure) + (value for respiratory rate)

The RTS has been shown to have high inter-rater reliability, demonstrated accuracy in predicting death and correlates well with the probability of survival. The RTS is heavily weighted towards the GCS to compensate for major head injury without multi-system injury or major physiological changes (Champion *et al.,* 1989). Table 2.2 demonstrates the predicted mortality rates in relation to RTS.

Table 2.2 Predicting mortality with Revised Trauma Score

Revised Trauma Score	Mortality (%)
12	<1
10	12
8	33
6	37
4	66
2	70
0	>99

Adapted from: Champion, H.R., Sacco, W.J. & Copes, W.S., Gann, D.S, Gennarelli, T.A. & Flanagan, M.E. (1989). A revision of the Trauma Score. *J Trauma.* **29**, 623-9

The reliability of RTS has been tested by Champion and coworkers in 1989 against two large databases containing 26,000 patients. Results showed that an RTS less than and equal to 11 accurately identified 97.2% of the fatally injured and most of the severely injured (using Regression analysis). The result also showed that, of 264 false negative patients (RTS=12 and severely injured), 167 had severe single body area injuries showing that there is a potential weakness of RTS if it is used alone (which emphasizes

the need for supplementation with anatomic criteria) and the decision to transfer a patient to a trauma center based on an RTS less than and equal to 11 provided 82% specificity and 59% sensitivity. RTS is also found to be related with mortality and probability of survival (Senkowski & McKenney, 1999). The RTS also yielded more accurate outcome predictions for patients with serious head injuries than the Trauma Score (Champion *et al.*, 1989).

However, there are a few limitations attached to the RTS. Chawda *et al.* (2004) reported that, the RTS is unable to score accurately intubated and mechanically ventilated patients, patients under the influence of alcohol or drugs, patients with rapidly changing physiological parameters as well as resuscitated patients.

In Netherlands, the RTS has been proposed as the standard instrument for assessing the severity of injuries in accident victims (Roorda *et al.*, 1996). The RTS is a physiological measure of the well-being of an individual who has sustained an injury. It is primarily used to determine injury after a traumatic event and is not intended for use with poisoning, choking, etc (Beattie *et al.*, 1998).

Presently, there is no proper scoring done on trauma patients presented in HUSM that could be used as the basis to decide on the management of these cases.

1.4 The importance of the study

Of all MVCs in Malaysia, the high occurrence of motorcycle fatal accidents (60%) (Radin Umar *et al,* 1998) warrants a high degree of concern. Apart from being largely populated, motorcyclists are also vulnerable and are highly exposed to fatality risks on the road. Injury is also a leading contribution to health-related economic losses (Mock, 2001). Orsay *et al.* (1995) wrote that motorcycle trauma patients with severe or critical head injuries used a significantly greater proportion of ICU days and hospital charges than those with mild or no head injuries

Accident prevention and injury reduction is better than improvements in hospital treatment for trauma patients (Wyatt *et al.*, 1999; Ankarath *et al.*, 2002). Improving pre-hospital and in-hospital trauma care can decrease the trauma mortality rate but these procedures are not useful for a significant portion of the patients who die at the scene of the accident. A study done by Wyatt *et al.* (1999) on fatal motorcycle collision in South-east Scotland found that most of the death of motorcyclists after road traffic collision occurred before they reached hospital and no motorcyclists died in hospital from minor injuries. They divided pre-hospital deaths into motorcyclists who were found dead on scene, and those who were found alive initially but died at the scene later and those who died in transit to hospital. It was demonstrated that the majority of those who died before reaching the hospital were already dead when found. This means that there is a limited potential to significantly reduce the death rate by improving pre-hospital medical attention. This is supported by Wong *et al.* (2002) who found that 42% of all trauma-related death in Singapore was pronounced dead at the scene of the accident, 15% in the Emergency Department, 2% in the operating theater, and 41% in

the ward with the median time of death of 67 minutes and 47% deaths occurred in the first hour.

Hence, it is vital to identify the trends of MVCs and injuries as well as the factors that correlate with the severity of motorcycle accidents in order to provide information which would be useful to identify priorities for motorcycle injury prevention and education among motorcycle riders. This information is also essential for the Public Health Policy and direct emergency medical health service resource allocations. Identification of potential risk factors also have important implications to other relevant official organizations involved in modifying safety measures that will reduce the occurrence of severe motorcycle accidents, which eventually, would help to promote a safe road environment.

Most of the studies on MVCs available today were conducted in the western countries and hence, it is not surprising that the pattern and trends of MVCs and injuries differed accordingly to the time of the studies and the places where they were conducted. Therefore, it is important to carry out a study based on local data in order to gather scientific evidence about the local situation that is applicable to local communities.

1.5 Conceptual framework for the injury severity among motorcyclist accidents

The severity of injury among motorcyclists' accidents can be considered conceptually to be the result of an interaction between human factors, environmental influences, vehicle factors, and mechanism of injury itself as explained in Figure 1.1.

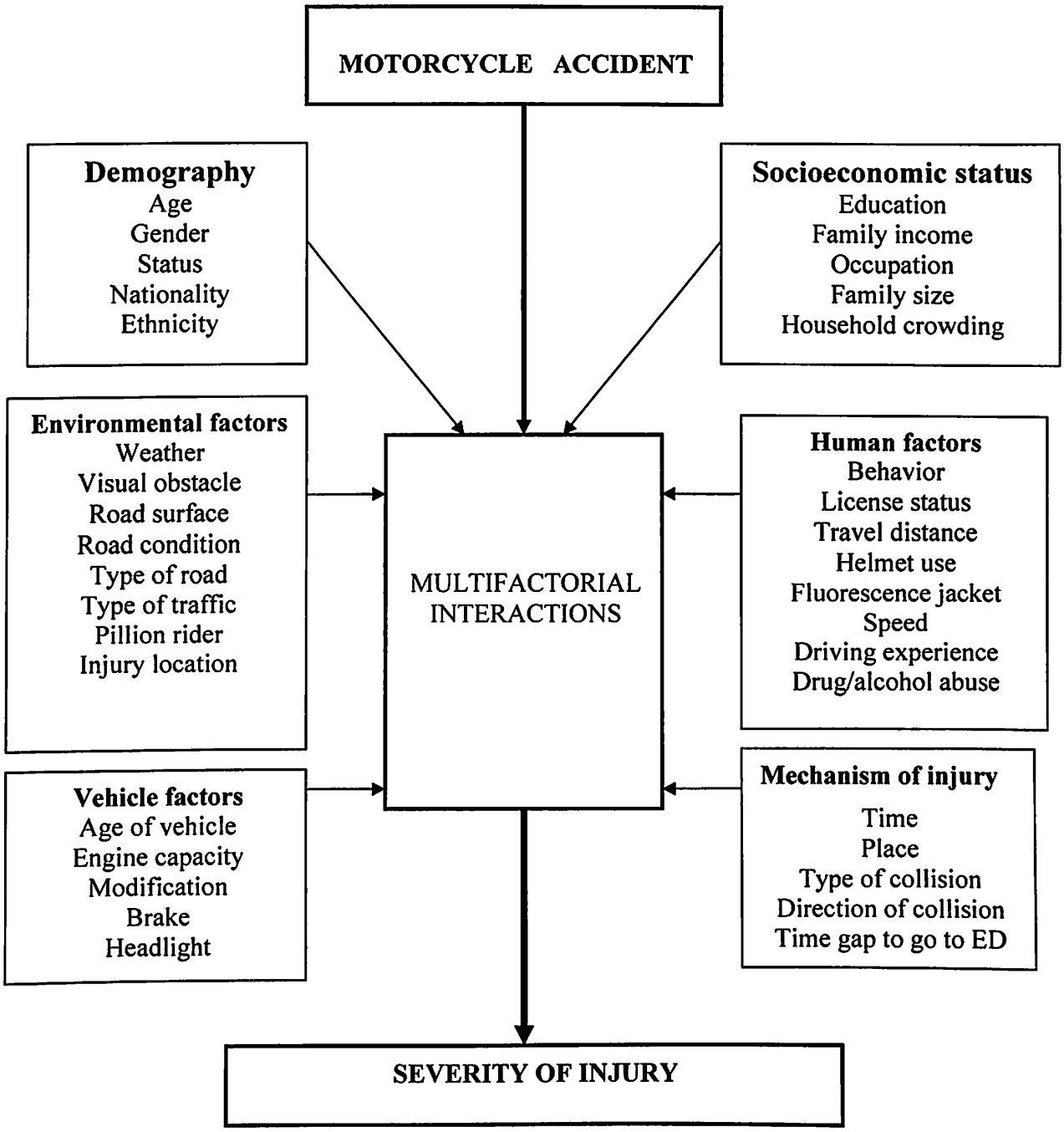

Figure 1.1 Conceptual frameworks for determining the severity of the motorcyclist injuries

CHAPTER 2

OBJECTIVES AND HYPOTHESES

2.1 General Objective

To study the trends of motorcycle accidents and injuries and factors contributing to the severity of the injury

2.2 Specific objectives

1. To describe the trend of motorcycle crashes and injuries in Kelantan, between 1998-2003

2. To identify factors associated with the severity of injury sustained by motorcyclists' accident as seen in HUSM from September 2003 to January 2004

2.3 Research questions

3.2.1 What is the trend of motorcycle crashes and injuries in Kelantan (1998-2003)?

3.2.2. What are the factors associated with the severity of injury sustained by motorcyclists' accident seen in HUSM?

2.4 Research hypothesis

There are relationships between injury severity of motorcyclists' accident patients with the following factors: ethnicity, gender, age, status, socioeconomic level, motorcycle status, age of motorcycle, engine volume, brake condition, headlight, riding experience, motorcycle license, riding speed, riding distance, helmet use, fluorescence jacket use, dress color and personality of the riders, roadway category, roadway alignment, type of road, presence of hole or not on the road, road surface, weather, visual obstacle, pillion riders, time of accident and day of accident.

CHAPTER 3

LITERATURE REVIEW

3.1 Epidemiology of Motorcycle Crashes

3.1.1 Worldwide

Between 1990 and 2020, it is estimated that MVCs will move from the ninth to the third largest cause of death and disability globally. Over 90% of this death and disability will occur in the developing world, in which a large proportion of vehicles are two or three wheeled. In many developed countries, motorcyclists suffer a disproportionate number of MVCs (Mullin *et al.*, 2000). This is supported by Ferrando *et al.* (2000) who reported that Spain ranks third in mortality due to traffic injuries (among the European Union). Out of four injury cases is a pillion of a motorcycle or a moped. In urban areas, 40% of traffic injury cases involved two wheel motor vehicle users. In the UK, 50.9% of all road traffic accidents caused severe trauma of which 16.8% had been motorcycle accidents (Sinha *et al.*, 1995).

Motorcycles are rapidly being introduced into many developing countries. Unfortunately, it was done with little thought to their hazardous nature. In Indonesia, motorcycles were involved in 64% of all traffic injuries and comprising 33% of total trauma patients presenting to emergency departments (Conrad *et al.*, 1996) and in Singapore, Yuan (2000) reported that the total number of road casualties in 1996 were 7853, out of which motorcyclist and pillion riders comprise the most vulnerable group of motorists, accounting for 49.9% (3919) of the total number of fatalities and casualties. In another study in Singapore by Quddus *et al.* (2002) it was found that, total

motorcycle accidents in this country in 2000 were 3,921 and the total number of fatal motorcycle accidents each year is relatively constant with an average of 105 fatalities per year.

A study on all trauma-related deaths in Singapore in 1995 found that 39.8% of the victims were motorcyclists with the median age of 24 years (Wong *et al.*, 2002). Another study among children with transport related injuries in Tehran showed that motorcyclist accidents constitute 25% of the injuries with boy/girl ratio of 9.9 (Zargar *et al.*, 2003). In Taiwan, 43% of the 2717 deaths from traffic injuries in 1992 were motorcycle riders, and of these motorcyclist deaths, 31% were young riders aged 16-25 years with the incidence rate of motorcycle crashes per 1000 person years of 358 (Lin *et al.*, 2003). Motorcycle crashes also accounted for the majority of traffic injuries in Thailand where it constituted approximately 80% of traffic trauma with 90% of the patients being under 40 years old (Ichikawa *et al.*, 2003).

3.1.2 Malaysia

In Malaysia, motorcycles are one of the most important forms of personal transportation. As in most developing countries, road traffic has increased in Malaysia. The average annual traffic growth is approximately 17% per year (Radin Umar *et al.*, 1996).

About 53% of the registered vehicles in this country are motorcycles and their proportion on the road varies between 35 to 68%, depending on places. Casualties among motorcyclist form a large portion of traffic injury problems in Malaysia and are

ranked among the highest in comparison to other countries. Approximately 68% of all injuries in Malaysia involve motorcyclists and their overall relative risk is about 20 times higher compared with the passenger cars (Radin Umar *et al.*, 1998).

According to Royal Malaysian Police (2001), the number of registered private motorcycles in 2001 was 5,609,351 compared to 5,356,604 in 2000 (49.63% and 50.54% out of total registered vehicles respectively). The rate of motorcycle injuries was 141 per 1000 populations. The rates of motorcycle crashes per 10 kilometers were 12.20, 12.00, 12.60, and 13.53 in 1998, 1999, 2000 and 2001 respectively. When compared to the rates of total MVCs, motorcycle crashes constitute a large proportion (Rates of total MVCs were 33.30 (1998), 35.21 (1999), 39.51 (2000) and 41.84 (2001)).

The trend in serious injuries to motorcyclists closely followed the trend in motorcycle registration (Langley & Alsop, 1998). Based on Royal Malaysian Police (2000), increasing number of registered motorcycles was related to the increasing number of fatal motorcycle crashes. The rates of fatality among motorcyclist crashes per 10,000 registered motorcycles were 6.35 (1998), 5.83 (1999) and 5.82 (2000).

In 2003 alone, a total number of 95,545 motorcycles were reported to have been involved in MVCs resulting in 34,248 injuries in Malaysia. Out of the total of 6286 fatalities and 46,455 serious and slight injuries throughout the country in 2003, approximately 56.4% (3548 cases) of all fatalities and 66.1% (30,700 cases) of all casualties were motorcycle riders and pillion riders (Royal Malaysian Police, 2003).

In Kelantan, injuries and poisoning are the second most common causes of hospital admission in year 2000 and 2001 (JKNK, 2000 & JKNK, 2001). In 2003, a total number of 6862 of all MVCs were reported in Kelantan resulting in 2575 injuries. Approximately, 52.2% (164 cases) of all fatalities and 70.9% (2411 cases) of all casualties out of a total of 314 fatalities and 3402 serious and slight injuries in Kelantan were motorcycle riders and pillion riders (RMP, 2003).

3.2 Mortality and Morbidity related with motorcycle crashes

Motorcyclists are most vulnerable to fatal MVCs. Radin Umar *et al.*, (1998) commented that, motorcyclists constitute nearly 60% of all fatalities in Malaysia. According to Royal Malaysian Police (2001), 40.9% of total fatal MVCs involved motorcycle and the fatality rate per 10 kilometers road length was 0.47 with no much change since 1998. Motorcycle crashes are an important cause of morbidity and mortality especially in young males. Sinha *et al.* (1995) stated that of those admitted to hospital due to motorcycle injuries, the average length of stay was 38.7 days (range 1-25 days), 67% needed intensive therapy unit and 41.3% needed ventilation for an average 3.55 days (range 1-17 days).

Numerous studies on the risk of fatal injury due to motorcycle crashes have been done. Roudsari *et al.* (2004) reported that the mortality rate for motorcyclists was 2.1%. Another study by Leonard & Frick (1998) stated that the fatality risk of the riders exceeds that of the pillion riders by 26±2 %. The relative risk of mortality between motorcyclists and motorcar drivers was 18.8:1 (Wong, 2002). It was also found that, multiple crashes were more prone to be fatal than a single crash (OR=2.67, 95%

CI=1.68, 4.23) and an attributable risk percent was 62.6% (Ichikawa *et al.*, 2003). The OR of fatal to non-fatal injury in motorcyclists aged ≥65 was13.44 (95% CI=2.54, 71.05) while in those less than 30 years was 6.67 (95% CI=1.49, 29.95) (Valent *et al.*, 2002).

Many studies have shown that the use of helmets as a protective device can reduce the fatality rate among motorcyclists. Valent *et al.* (2002) reported the OR of fatal to non-fatal injury by not wearing a helmet was 1.73 (95% CI=0.45, 6.70). Another study by Petridou *et al.* (1998) reported that motorcycle riders in Greece who wore helmets had a reduced mortality rate (OR=0.64, 95% CI=0.51, 0.81) compared to those who did not wore their helmet.

Even though a lot of studies commented that helmets do reduce the incidence of significant brain injury and severe facial injury during accidents, Yates & Dickensen (2002) wrote on three case-reports to highlight the risk of facial trauma even in low speed accidents. Indeed, head and facial injuries are a major concern for motorcyclists as they are a significant cause of morbidity and in some cases mortality following motorcycle crashes. He also wrote that approximately a quarter of all motorcyclists involved in crashes suffered from some form of maxillofacial injury, with approximately twice as many non-helmeted riders suffering from facial injuries (12.8%) than helmeted riders (6.8%). This is supported by Lin *et al.* (2001) who wrote that crashes involving unhelmeted riders were not only more severe but also more frequently involved facial and head injuries than crashes involving helmeted riders.

3.3 Factors associated with motorcycle crashes

A number of risk factors have been established in the relationship between road users and MVCs. Factors that are of importance are related to the road-user, the vehicle as well as road and traffic conditions (Subramaniam, 1998).

3.3.1 Age and gender

Age and gender of the driver have been considered as risk factors affecting accident severity in many studies. Male motorcyclists usually exhibit a higher probability to become involved in serious/fatal accidents (Yau, 2004; Wong *et al.*, 2002; Valent *et al.*, 2002; Zargar *et al.*, 2003; Roudsari *et al.*, 2004; Lin *et al.*, 2003; Dessie & Larson, 1991).

Age could be connected to certain motivational and lifestyle factors that may lead to risky driving. Numerous studies have found that younger riders have an increased probability of being involved in MVCs (Dessie & Larson, 1991; Quddus *et al.*, 2002; Subramaniam, 1998).

However, the elderly are the most vulnerable road users. In fact, they have the highest risk of death after an accident, probably because of co-morbidity, which reduces the possibility of recovery from trauma. Shankar & Mannering (1996) reported that although older riders tend to ride at lower speeds and hence less likely to be involved in an accident, they tend to have more severe injuries once involved in an accident.

3.3.2 Nationality

It is known that nationality does play a role in reducing the risk of getting less severe injury. Quddus *et al.* (2002) found that Singaporeans have about 36.3% lower probability of dying in an accident relative to other nationalities as local people are more familiar with the conditions of the roads and the regulations in their own country.

3.3.3 Educational status

Status of education of the road users can affect the probability to involve in MVCs. Lin *et al.* (2003) reported the same results. They found that students whose mothers had a high school education had a higher risk of crashing than those whose mothers had an elementary school or no formal education.

3.3.4 Socioeconomic status

Economic status was found to be associated with the risk of MVCs involvement. Murrray (1998) stated that majority of young motor vehicle drivers involved in MVCs were from families of lower sosio-economic status compared to those from intermediate and upper non-manual groups. They also found a high occurrence of motorcycle crashes among sons from single-parent families.

3.3.5 Ownership of the vehicle

Ownership of the vehicle also was noted to have association with the risk of MVCs. Riders who owned a motorcycle had an increased risk of being involved in motorcycle accidents compared to own by his or her family (Lin *et al.*, 2003).

3.3.6 Headlight on

In July 1992, a nationwide daytime running headlight intervention was introduced as a one of the road safety measure in terms of collision reduction in Malaysia. Radin Umar *et al.* (1996) established a statistical model to look on the effect of the above intervention and found that this intervention has resulted in about 29% less conspicuity-related accidents to motorcyclists. A Singaporean study also found that headlight on during the day time tends to result in less severe injuries and less severe damage to the motorcycle (Quddus *et al.*, 2002).

3.3.6 Speed

It is generally believed that speed increases the occurrence and the severity of MVCs. A higher riding speed was found to be positively associated with the risk of motorcycle accidents with the relative hazards of 1.87 (95% CI = 1.11-3.12) for 61-80 kilometer-per-hour (kph) compared to less than and equal to 20 kph (Lin *et al.*, 2003). As the riders increase the speed, the likelihood of fatality and more serious injury will increase as well (Shankar & Mannering, 1996).

3.3.8 Helmet use

Helmet use was found by many studies to be a definite factor for MVCs as well as severity sustained from the injuries. Petridou *et al.* (1998) reported that 38% of motorcycle deaths could have been avoided if all motorcycle riders used helmets. Liu, et al. (2004) estimated that helmet can reduce the risk of head injury up to 72% (OR=0.28, 95% CI=0.23, 0.35). However, Conrad *et al.* (1996) wrote that although motorcycle drivers appear to comply with the motorcycle helmet law, it is a "token compliance". Helmets maximally protected less than 50% of motorcyclists and very little safety consciousness was found among drivers. Ankarath *et al.* (2002) looked at 1239 patients to identify factors that are likely to predict a reduced survival following motorcycle crashes, and gave a comment on the compliance of safety helmet usage among motorcyclists in the UK. It was noted that females were more likely to have used a helmet than males (Ichikawa *et al.*, 2003). This is supported by Zargar *et al.* (2003) who found that only 2.7% of all motorcyclists wore helmets at the time of accident and Roudsari *et al.* (2004) who reported that only 6% of the male motorcyclists used helmets.

Studies have reported that helmet usage has an interaction with other factors. Shibata & Fukuda (1994) found that speed was the strongest risk factor of fatality for both motorcyclists and motorcar drivers for both sexes. It was found that speed seemed to be more critical for motorcyclists than motorcar drivers and that the effectiveness of helmet use by male motorcyclists was dependent upon speed at the time of accident, suggesting an interaction between helmet use and speed. This study also showed that helmet use was definitely protective at low speed of ≤50 km/h and ineffective at high

speeds of over 50 km/h. Helmet use also showed an interaction with collision with fixed objects. Shankar & Manering (1996) reported that helmeted riders have an increased likelihood of being fatally injured when collided with a fixed object.

3.3.9 Consumption of alcohol

Alcohol consumption has been suggested as a co-morbid factor in major trauma. Peng & Bongard (1999) commented that those with blood alcohol detected had a higher Injury Severity Score, lower Revised Trauma Score, and lower Glasgow Coma Scale than those without. A Singaporean study on road traffic accident mortality showed that alcohol was detected in 16.7% of motorcyclists and 18.7% of victims had positive blood alcohol level ranging from 13 mg/dL to 292 mg/dL (Wong *et al.*, 2002). Lin *et al.* (2003) reported that the relative hazards among riders who drank alcohol to be involved in MVCs was 1.40 (95% CI=1.27, 1.54). Shankar & Mannering (1996) reported the same results of which alcohol-impaired riding increased the likelihood of fatality, evident, and disabling injuries.

3.3.10 Risky behavior

Risky behavior has long been implicated with motorcyclist crashes. This is as demonstrated by Stella *et al.* (2002) where a large proportion of head injury related motorcycle crash deaths are related to the unsafe behavior of motorcyclist such as alcohol consumption, speeding, lack of appropriate safety equipment and drug abuse.